INTERIM DATA EVALUATION SUMMARY

LOWER PASSAIC RIVER RESTORATION PROJECT

Prepared by:

Malcolm Pirnie, Inc.

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Version: 2005/12/23

1.0 INTRODUCTION

The Malcolm Pirnie Team is evaluating historical and new Passaic River data to support the refinement of the conceptual site model (CSM), to guide field investigation planning, and ultimately to contribute to the preparation of the *Round 1 Data Gap Report/ Supplemental Work Plan*. This letter report is an interim submittal intended to summarize the data evaluations that occurred between April and October 2005. Note that the data discussed in this report are provided in the attached appendices; however, data interpretations and discussions will be included in the updated CSM, which is anticipated to be completed after the currently scoped historical geochemical evaluation is approved.

2.0 DATA EVALUATIONS FOR THE HIGH RESOLUTION CORING PROGRAM

Data evaluations were necessary to develop the high resolution coring program and to choose appropriate sampling locations. As part of this evaluation, the following information and data sets were considered:

- Historical total dichlorodiphenyltrichloroethane (DDT) and radionuclide profiles (Tierra Solutions, Inc. 1995 data set).
- Historical bathymetric surveys and associated sedimentation rates [Attachment B of the Lower Passaic River Restoration Project Work Plan (Malcolm Pirnie, Inc, 2005a)].
- Surficial sediment texture interpreted from draft side-scan sonar imagery [June 2005 geophysical survey (Aqua Survey, Inc., 2005)].
- Geotechnical borings and associated fence diagrams [June 2005 geophysical survey (Aqua Survey, Inc., 2005)].
- Beryllium-7 concentrations in surficial sediment (August-September 2005 Malcolm Pirnie sampling).

The purpose of the evaluation was to identify locations likely to yield high resolution sediment cores with a continuous geochronology. To accomplish this objective, geochemical and geophysical data were first evaluated to identify depositional areas with thick sediment beds containing silt. Refer to Section 4.2.2 of the Lower Passaic River Restoration Project Field Sampling Plan (FSP) Volume 1 (Malcolm Pirnie, Inc., 2005b) for more details on these evaluations. In general, depositional environments were identified from a consideration of areas with relatively high sedimentation rates, calculated from bathymetric surveys (conducted from 1989 to 2004), and from an examination of the vertical limit of total DDT contamination (Attachment 1). Note that the peak polychlorinated dibenzo-p-dioxin (PCDD) loading is expected to occur at shallower depths in a sediment core than the peak total DDT loading, reflecting the historical industrial patterns on the Lower Passaic River (Bopp *et al.*, 1991). Hence, by using total DDT as a marker and mapping the depth of total DDT contamination, the PCDD contamination is also encompassed. Thick silty sediment beds were also identified from interpreted draft side-scan sonar imagery (Attachment 2) presented as surficial sediment texture as well as “Fence Diagrams” showing sub-bottom geological units (Attachment 3). Based on these data evaluations, 13 target coring areas were identified as discussed in Section 4.2.3 and presented in Figure 4-2 of FSP Volume 1 (Malcolm Pirnie, Inc., 2005b).

Within these target areas, additional historical data were then considered to further refine the potential high resolution coring locations. Radionuclide data collected in 1995 were evaluated to identify sediment beds that had a continuous cesium-137 profile. Refer to Attachment B of the Work Plan (Malcolm Pirnie, Inc., 2005a) for profiles and information compiled by W.J. Hansen (City University of New York in Manhattan, 2002). To confirm that potential coring locations were located in a depositional environment, a preliminary sediment sampling program was then conducted in August-September 2005. As part of this program, surface grab samples were collected at potential coring locations and analyzed for beryllium-7 and cesium-137. Sediment samples with high beryllium-7 and low cesium-137 concentrations typically represent locations possessing recent sediment deposits. Attachment 4 summarizes the 2005 surface sediment radiological data and the rationale for selecting the final 15 high resolution coring location for the September-October 2005 field work.

During the historical radionuclide data evaluation, the Malcolm Pirnie Team became aware of a discrepancy in historical sampling locations as listed in the Passaic River Estuary Management Information System (PREmis) database. Specifically, the northing and easting coordinates were projected incorrectly in the database (Attachment 5). Note that the PREmis database and its public counterpart provided on www.ourpassaic.org have now been updated with the corrected coordinates. Concerns were also expressed by the Cooperating Parties with respect to the assignment of new labels to historical core locations sampled by Tierra Solutions, Inc. (refer to the September 19, 2005 letter from de maximis, inc. to the US Environmental Protection Agency). The new labels were needed to assign unique identifiers in the PREmis database, since it is compiled from multiple sources. Assigning unique identifiers is a common and accepted practice in such large database development endeavors, and they are being retained for maintaining database organization. However, it is not necessary to use these new labels for reference external to the database itself, and future project deliverables will use the location labels originally assigned by Tierra Solutions, Inc. for consistency with historical documents.

3.0 DATA EVALUATION FOR THE WATER COLUMN PROGRAM

Data evaluations were also necessary to design a water column program that would yield a scientifically-defensible, yet cost-effective, data set. Moreover, the quality of the water column data set must be sufficient to evaluate contaminant fate and transport as well as to support the modeling needs of the complex Lower Passaic River tidal system. As part of this evaluation, the following information and data sets were considered:

- Historical surface water data for select chemicals (Tierra Solutions, Inc. 1997 “Outfall Sampling Program” and 1999 “Newark Bay Reach A Monitoring Program” data sets) and historical data from the US Army Corps of Engineers (USACE) 1993, 1994, and 1996 water sampling programs.

- Historical composite and particulate-phase surface water data for select chemicals (USACE 1999 "Drift Removal Monitoring Program" data set).
- Historical dissolved and particulate-phase water column data available on the Contaminant Assessment and Reduction Project (CARP) database for select chemicals, including polychlorinated biphenyl (PCB) homologues.
- Information on leading-edge technologies and water column sampling techniques.
- Consultation with various practitioners and academic experts.

The purpose of this evaluation was to assess gaps in the historical data and to evaluate water quality. By considering the available historical data, the Malcolm Pirnie Team was able to design a dual-round Sampling Methodology Validation Study to collect dissolved and particulate-phase contaminant concentrations in the water column. These experiments would address historical data gaps and would facilitate the design of a routine water column monitoring program to support preparation of the remedial investigation and modeling efforts. This historical evaluation included compiling dissolved and particulate-phase water column data from the CARP database and compiling composite, whole, and particulate-phase water column data from the PREmis database.

Note that the PREmis database contains publicly available data. Since the CARP data have only recently become publicly available, these data are not yet available on PREmis. However, the Lower Passaic Restoration Project team members, were given permission in October 2003 by the Hudson River Foundation to evaluate the draft CARP data for planning purposes (refer to the October 1, 2003 letter from the Hudson River Foundation to the US Environmental Protection Agency). The CARP data were collected for the New Jersey Department of Environmental Protection (NJDEP) by Stevens Institute of Technology (Stevens) in Hoboken, New Jersey. Dissolved and particulate-phase water column samples were collected from seven stations located from RM 0.69 to RM 12.45 in the Passaic River from November 1998 to March 2002. All samples were collected using a Trace Organics Platform Sampler (TOPS) equipped with an XAD column and glass fiber filter.

Water column results extracted from the CARP and PREmis databases were then plotted by river mile; some important observations that were assembled during this exercise include:

- CARP data are limited to 1998 through 2000 and do not extend upriver beyond RM 13. For the chemicals evaluated, the concentrations reported in the particulate phase were greater than the concentrations reported in the dissolved phase (Attachment 6).
- No clear trends were observed in the CARP data since concentrations varied by an order of magnitude and the number of sample points is limited (Attachment 6).

- PREmis data are limited to 1996 through 2000 and do not extend upriver beyond RM 8. Trends in the data set are difficult to compare and interpret since the sampling methodologies differed among the historical studies (Attachment 6).

By evaluating the historical water column data, the Malcolm Pirnie Team was able to make several decisions on the design of the initial water column program, specifically Infiltrex (a manufactured version of the TOPS) and Semi-Permeable Membrane Device (SPMD) sampling activities. Some important observations that were assembled during this exercise included:

- The distribution coefficients (K_D) for PCB homologues calculated from the CARP data were inconsistent (presented in tabular format in Attachment 7), suggesting that the CARP sampling technique (*e.g.*, TOPS) separated the dissolved and particulate fractions inconsistently. Hence, anticipated Infiltrex water column sampling would require a tighter mesh filter to determine the fate of dissolved-phase contaminants.
- Based on dissolved phase PCB homologue concentration and total suspended solids (TSS) values, the anticipated water volume to be sampled using the Infiltrex was increased from 20 liters to 100 liters to achieve the required detection limits.
- Since the SPMDs yield semi-quantitative results, the patterns presented in the PCB homologue data (presented graphically in Attachment 7) would be compared to the upcoming SPMD data to estimate dissolved phase concentrations. Note that while the SPMD results are semi-quantitative, the patterns in the PCB homologue data are expected to be similar to the patterns presented in the CARP data.

Concurrent with the historical data evaluation, consultations were initiated with analytical laboratories, academic experts, other practitioners, and members of the Technical Advisory Committee (TAC) to explore a variety of water column sampling strategies. Individuals contacted and their respective organizations include but are not limited to:

- Dr. Steve Larson [USACE Engineer Research and Development Center (ERDC) Waterways Experiment Station (WES)], analytical chemist, research chemist, and water sampling expert.
- Dr. Herb Fredrickson (USACE ERDC/WES) micro-filtration expert and microbial ecologist (knowledgeable on the impact of microbes on filters).
- Dr. Bruce Lee (Environmental Health Labs, Underwriters Labs), national expert on water extraction and analysis.
- Dr. Xiangru Zhang (University of Notre Dame), national expert on water sampling and analysis.
- Dr. Patricia Maurice (University of Notre Dame), national expert on surface/natural water sampling and analysis.
- Dr. Joel Baker (University of Maryland), national expert on water column sampling of contaminants.
- Dr. Simon Litten (New York State Department of Conservation), expert on TOPS sampling.

- Dr. Donald Yee (San Francisco Estuary Institute), expert on Infiltrex filtration and SPMD sampling.
- Gregory Cavallo (Delaware River Basin Commission), expert on water column sampling of the Delaware River.

A summary of water column methodologies evaluated by the Malcolm Pirnie Team is provided in Attachment 8. These summaries, which compare potential sampling methodologies and their corresponding cost effectiveness, were ultimately incorporated into Section 6.1.1 of the FSP Volume 1 (Malcolm Pirnie, Inc., 2005b). However, the key result was that no single water sampling method is known to be comprehensive enough to collect all necessary water column data to support the remedial investigation and modeling. Experts that were consulted had differing views on applicable techniques and minimum-required sampling volumes for the project. As a result, the Malcolm Pirnie Team elected to institute a Sampling Methodology Validation Study as part of the water column program [refer to Section 6.2.3 of the FSP Volume 1 for more details (Malcolm Pirnie, Inc., 2005b)]. This study involves evaluating and validating three water column methodologies, including the Infiltrex 300 (XAD resin and filtered solid samples), large volume filtration system (filtered solids and filtered water samples), and unfiltered-whole water samples. In addition, the study is designed to demonstrate which techniques and sampling volumes would be both easily implemented and representative for a long-term, cost-effective water column sampling program for the conditions encountered in the Lower Passaic River.

4.0 DATA EVALUATIONS OF BIOLOGICAL TISSUE DATA

Parallel to the development of the high resolution coring program and water column sampling program, an evaluation of historical biological tissue data was also completed. The purposes of the evaluation were to identify data gaps in the historical data and to assess contaminant residues in biological species sampled in the Lower Passaic River (Attachment 9).

As part of this evaluation, historical biological tissue data for select species and select chemicals from the PREmis database and CARP database were compiled and evaluated. Note that both databases contain information on a suite of species, however, to focus the evaluation the following criteria were considered: what data were available for each species, what portion of the life cycle did each species reside in the Lower Passaic River, and what trophic level did the species populate. Based on these criteria, blue crab, mummichogs, and white perch were selected because these species were resident species, they occupied different trophic levels, and data were available for the evaluation.

In general, contaminant residue in biological tissue (blue crab, mummichogs, and white perch) was presented graphically by river mile. In addition, preliminary biota-sediment accumulation factors (BSAF) were calculated in an effort to evaluate the impact of sediment contamination on the biota. Some important observations that were assembled during this exercise include:

- All the available biological tissue samples were collected from river mile (RM) 0 to 7; hence, a gap in biological tissue data exists for the upper 10 miles of the Lower Passaic River (Attachment 9).
- The majority of the biological tissue samples were collected from 1998 to 1999; hence, a limited amount of recent data is available for interpretation (Attachment 9).
- The tissue residues and BSAF are variable for the selected contaminants and species, resulting in scattered plots with no discernible trends. For example, the concentration of total DDT in blue crab tissue varied by a factor of 1000 (Attachment 9).
- Laboratory bioaccumulation data were limited to 1993 and to a single sampling location (Attachment 9).

Note that the evaluation of these data is not completed, and further discussion will be provided in the updated CSM.

5.0 ANTICIPATED FUTURE EVALUATIONS

We anticipate that a draft geochemical evaluation memorandum will be completed for internal review in January 2006. This memorandum will report on additional evaluations building on the data evaluations presented here as well as preliminary findings discussed in Attachment B of the Work Plan (Malcolm Pirnie Inc., 2005a). These data evaluations will contribute to future refinement of the CSM and support future field investigation planning and reports.

6.0 REFERENCES

Aqua Survey, Inc., 2005. Draft Technical Report: Geophysical Report, Lower Passaic River Restoration Report. August 2005.

Bopp, R.F., *et al.*, 1991. A Major Incident of Dioxin Contamination: Sediments of New Jersey Estuaries. Environmental Science and Technology, Volume 25, No. 5, pp. 951-956.

Hansen, W.J., 2002. A spatial and Statistical Investigation of Dioxin-Furan Contamination in the Sediment of the Hudson Raritan Estuary. Doctoral thesis from the City University of New York in Manhattan.

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Malcolm Pirnie, Inc., 2005b. Lower Passaic River Restoration Project Field Sampling Plan, Volume 1. Prepared in conjunction with Battelle, Inc. and HydroQual, Inc. August 2005.

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Tierra Solutions, Inc., 1997. PREmis Study Name "Passaic 1997 Outfall Sampling Program."

Tierra Solutions, Inc., 1995. PREmis Study Name "Passaic 1995 RI Sampling Program."

USACE, 1999. PREmis Study Name "1999 USACE Drift Removal Monitoring Program."

USACE, 1996a. Water Column Sampling. PREmis Study Name "96PEXXON: Exxon."

USACE, 1996b. Water Column Sampling. PREmis Study Name "96PPANYNJ: Port Authority New York New Jersey."

USACE, 1994a. Water Column Sampling. PREmis Study Name "94F36BU: Buttermilk."

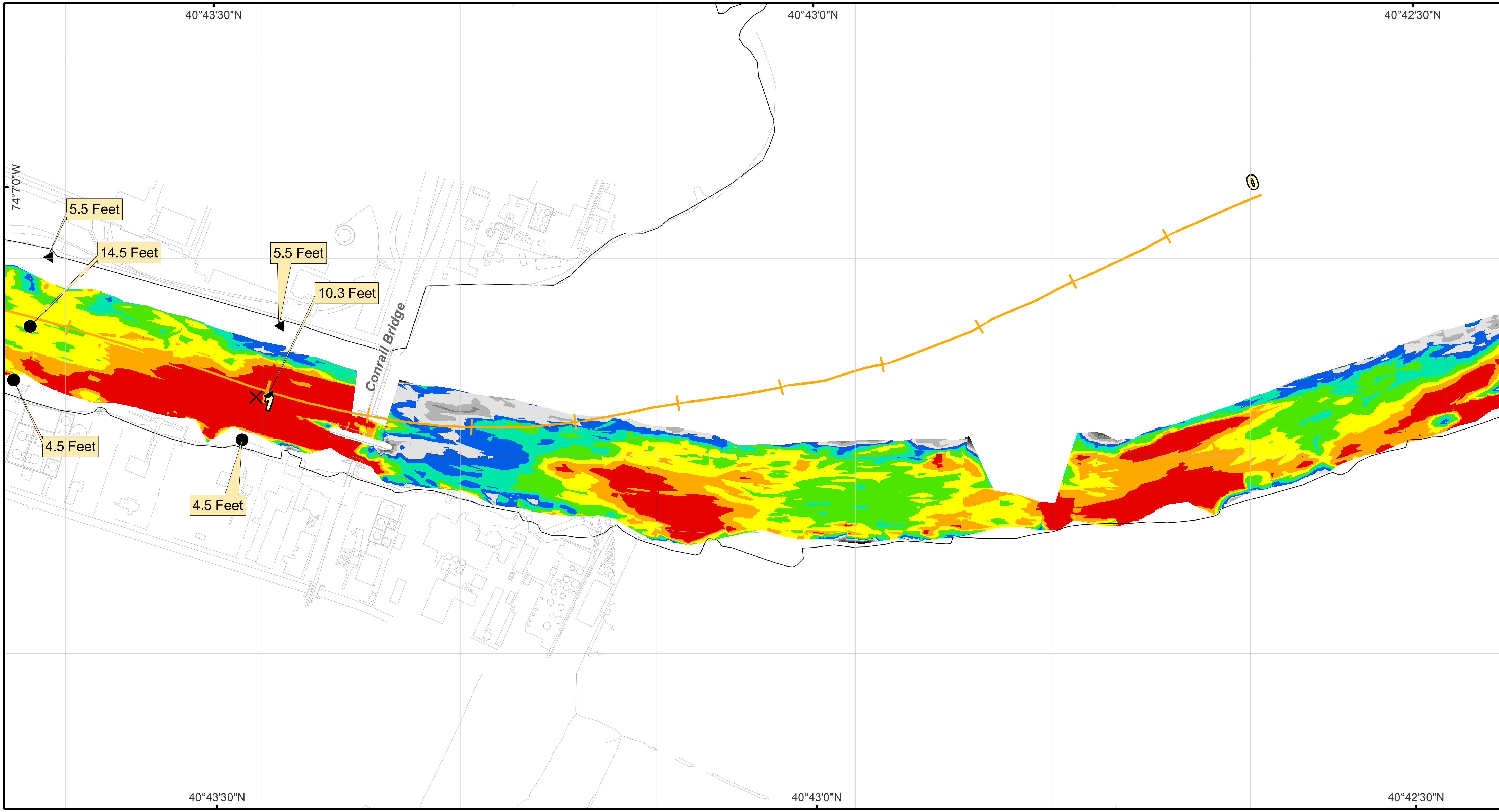
USACE, 1994b. Water Column Sampling. PREmis Study Name "94F41HU: Hudson River."

USACE, 1993a. Water Column Sampling. PREmis Study Name "93F64HR: Hackensack River."

USACE, 1993b. Water Column Sampling. PREmis Study Name "93F64PE: Port Elizabeth 93."

Attachment 1: Sedimentation Rates

One-mile-per-plate map book containing (1) sedimentation rates calculated using the 1989 and 2004 bathymetric surveys [refer to Attachment B of the Work Plan (Malcolm Pirnie, Inc. 2005a) for more details on method] and (2) depth of total DDT contamination calculated using the Tierra Solutions, Inc. 1995 data set [refer to Section 4.2.2 of the Field Sampling Plan Volume 1 (Malcolm Pirnie, Inc. 2005b) for more details on method]. Note that sedimentation data extend to RM 15 and total DDT data extend to RM 6.7.



Lower Passaic River Restoration Project
New Jersey

Sedimentation Rate (1989-2004) & Depth of Total DDT Contamination

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

Total DDT Coring Location

- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

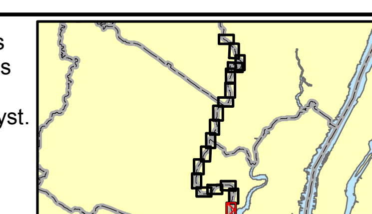
0 250 500 1,000

1 " equals 500 '

A Triangulated Irregular Network (TIN) was derived from the survey points using ESRI's 3-D Analyst in ArcGIS. Contours were interpolated from the TIN, also in 3-D Analyst.

Bathymetric Control Data:
Benchmark: X 71 (NGS PID: KV0256)
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 0 to 1

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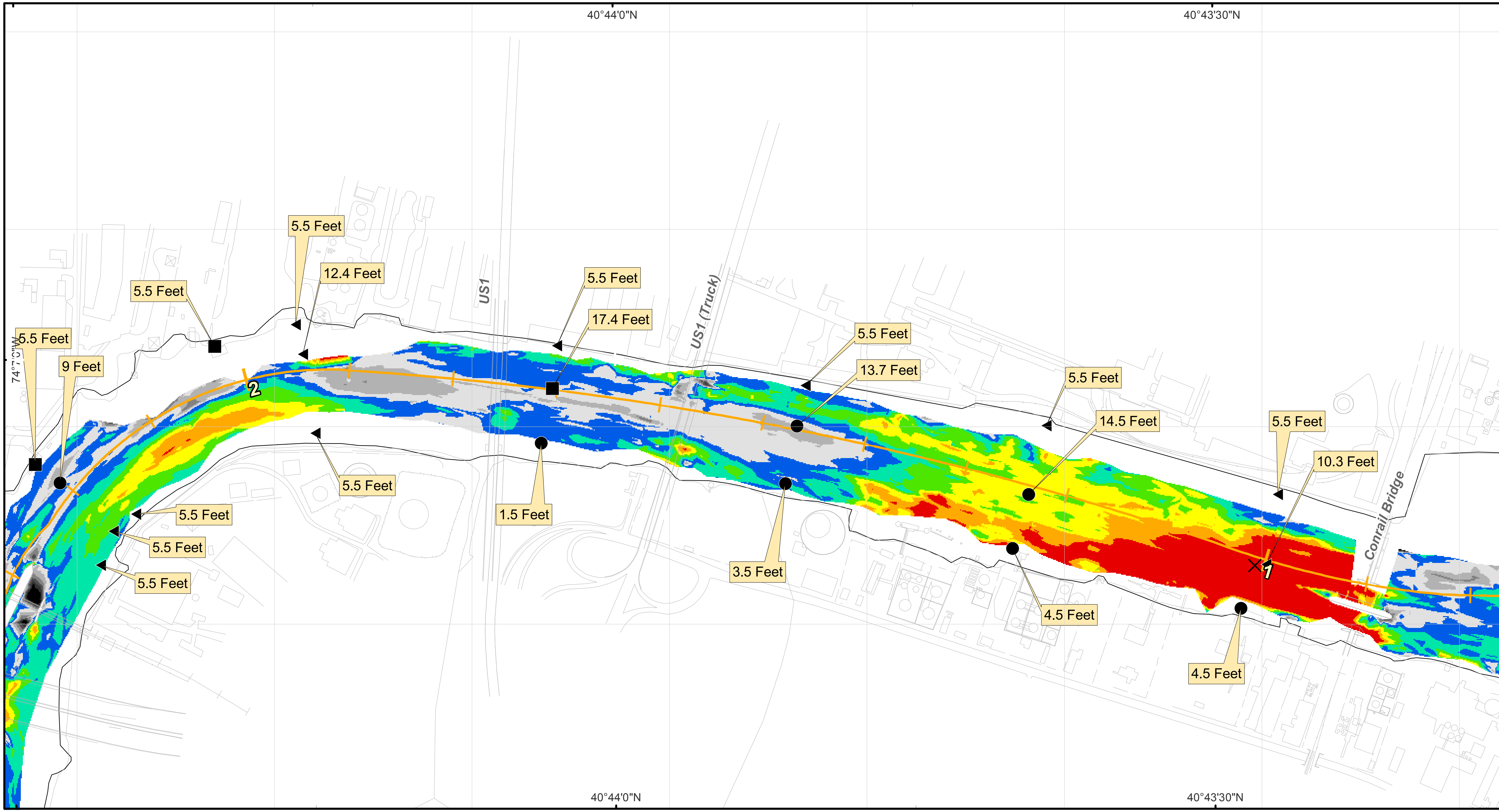

Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

US Army Corps
of Engineers

MALCOLM PIRNIE

Legend

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- 2 to 3
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- 4 to 5
- \> 5

Total DDT Coring Location

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- Incomplete Declining Core
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Depth of Contamination (Feet)
marked in call-out boxes.

- River Mile Post

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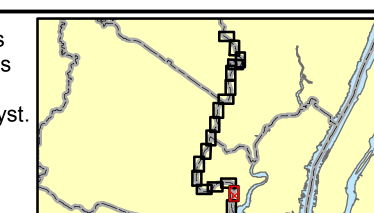

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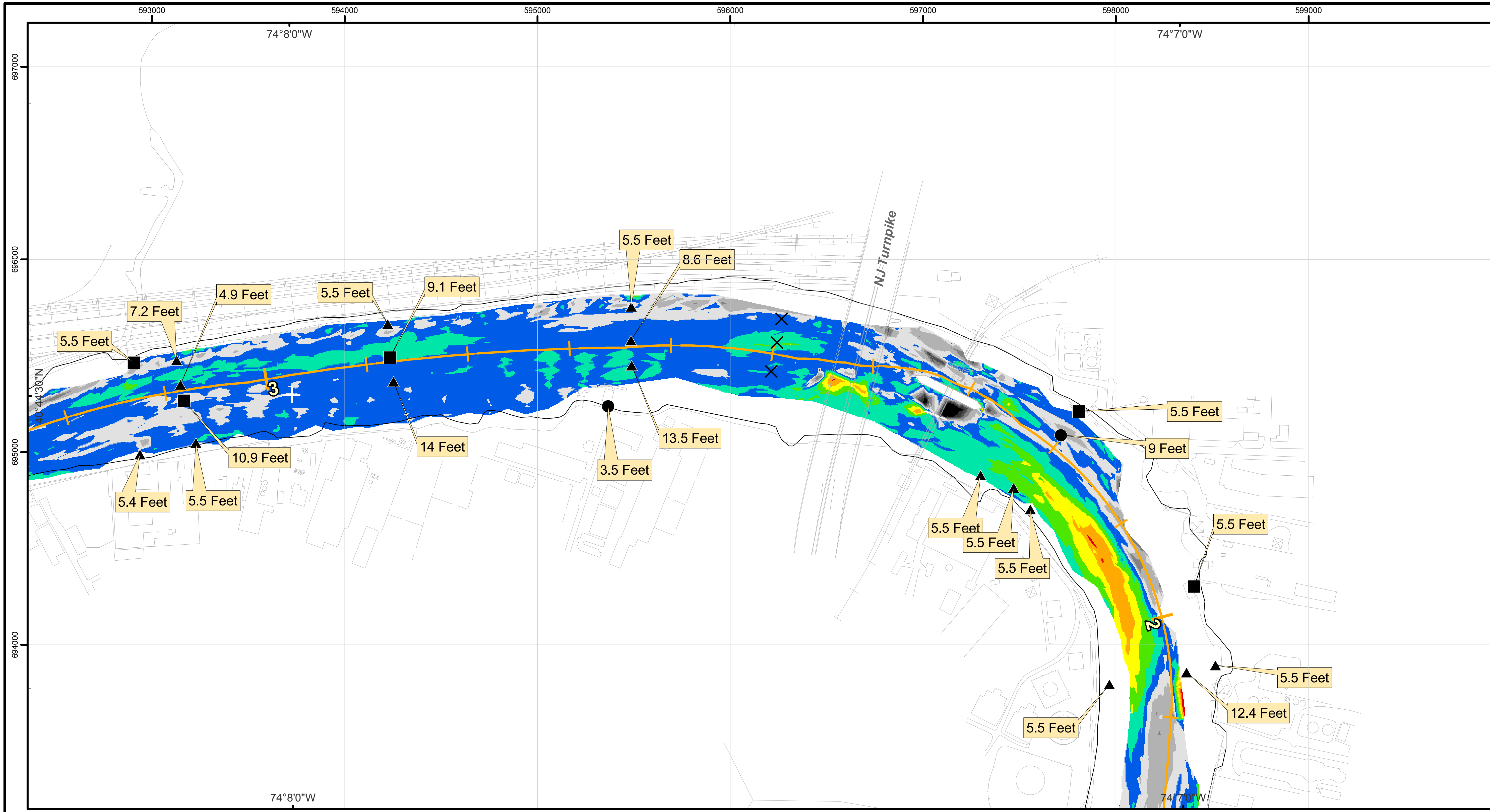

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US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

Legend

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- 4 to 5
- > 5

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Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

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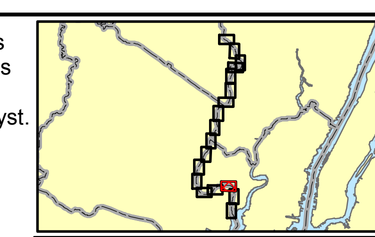

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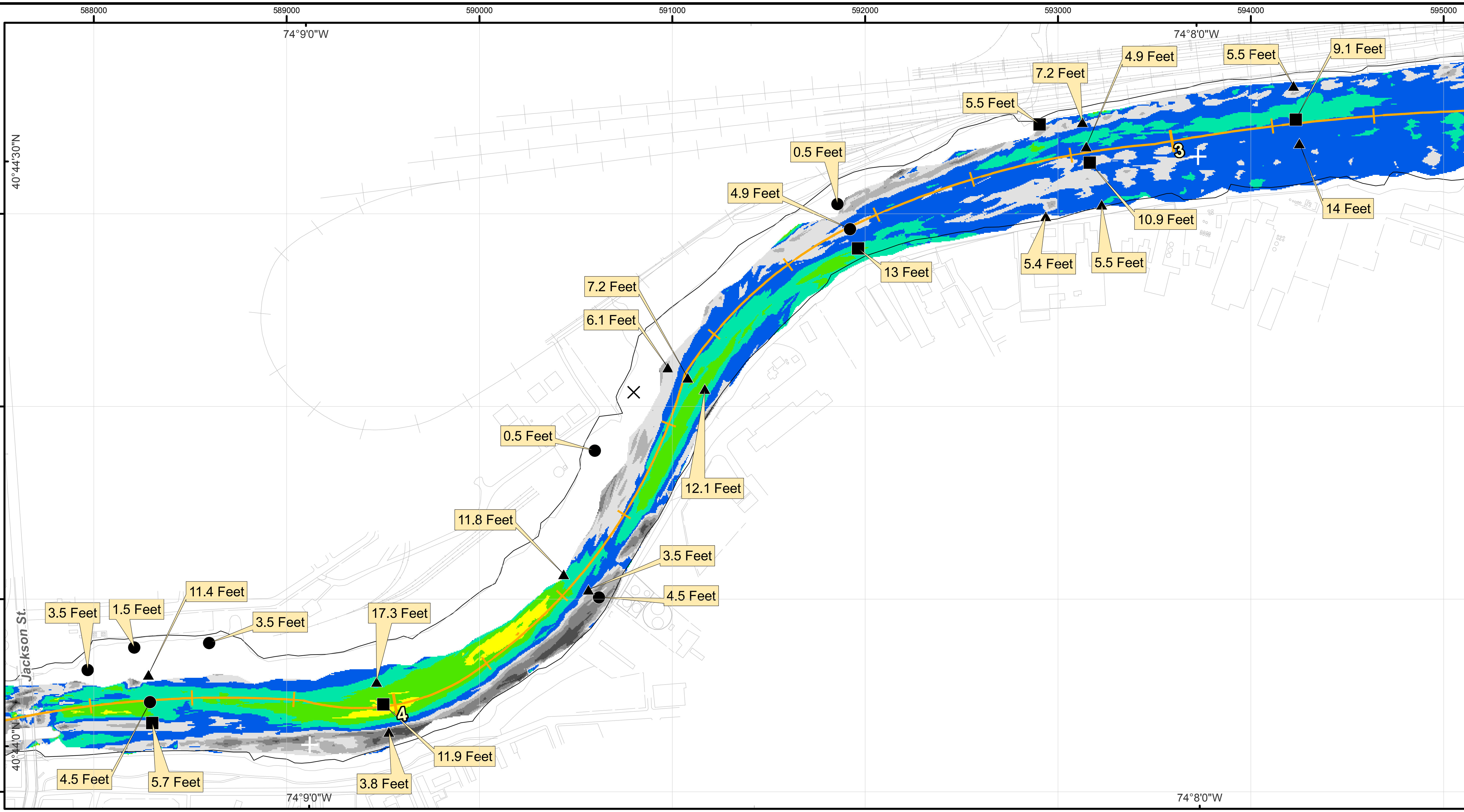

Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004) & Depth of Total DDT Contamination

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

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Mile 3 to 4

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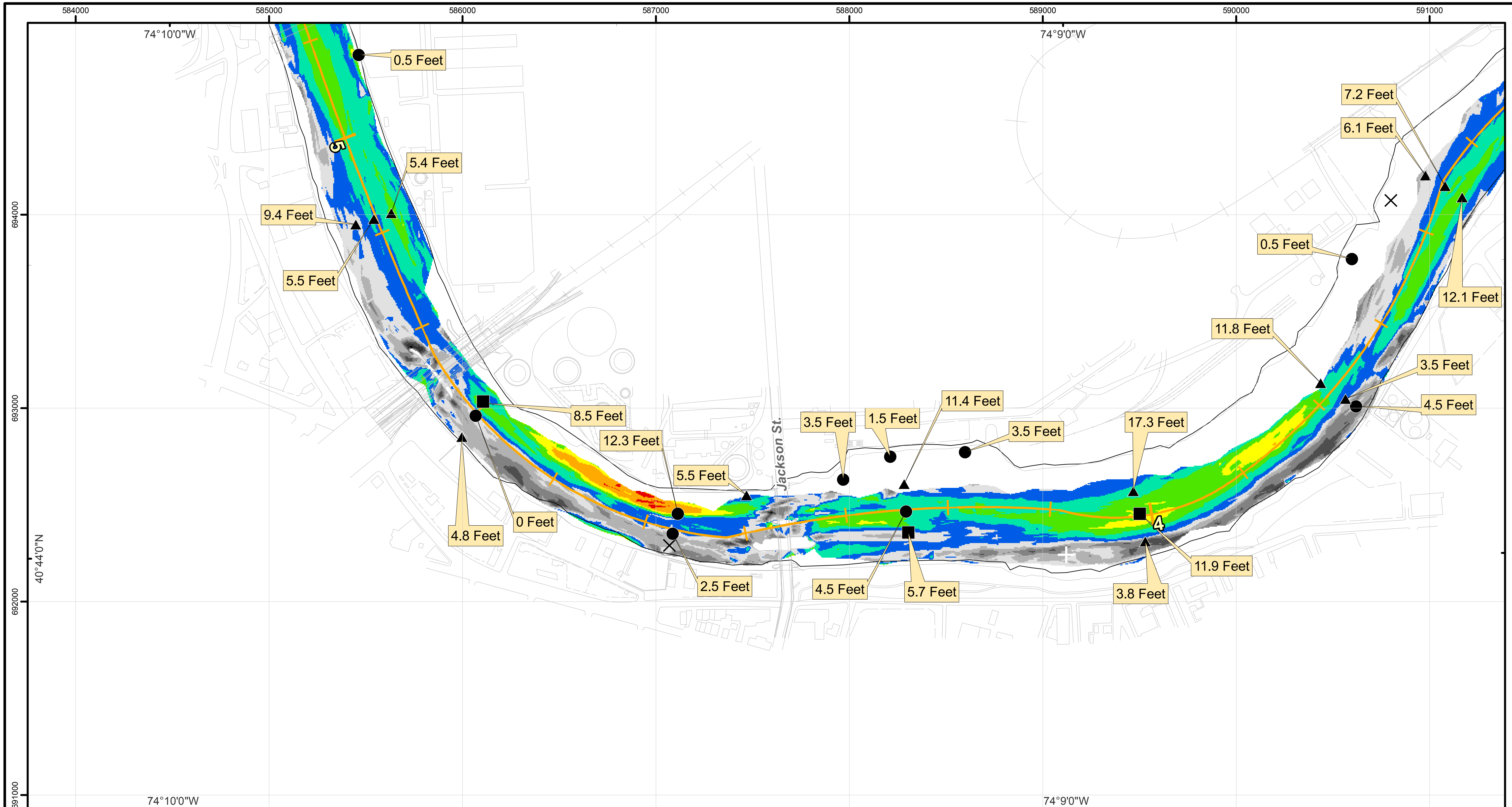

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US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project
New Jersey

Sedimentation Rate (1989-2004) & Depth of Total DDT Contamination

Legend

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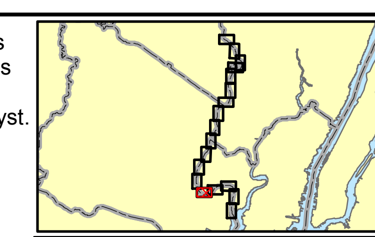

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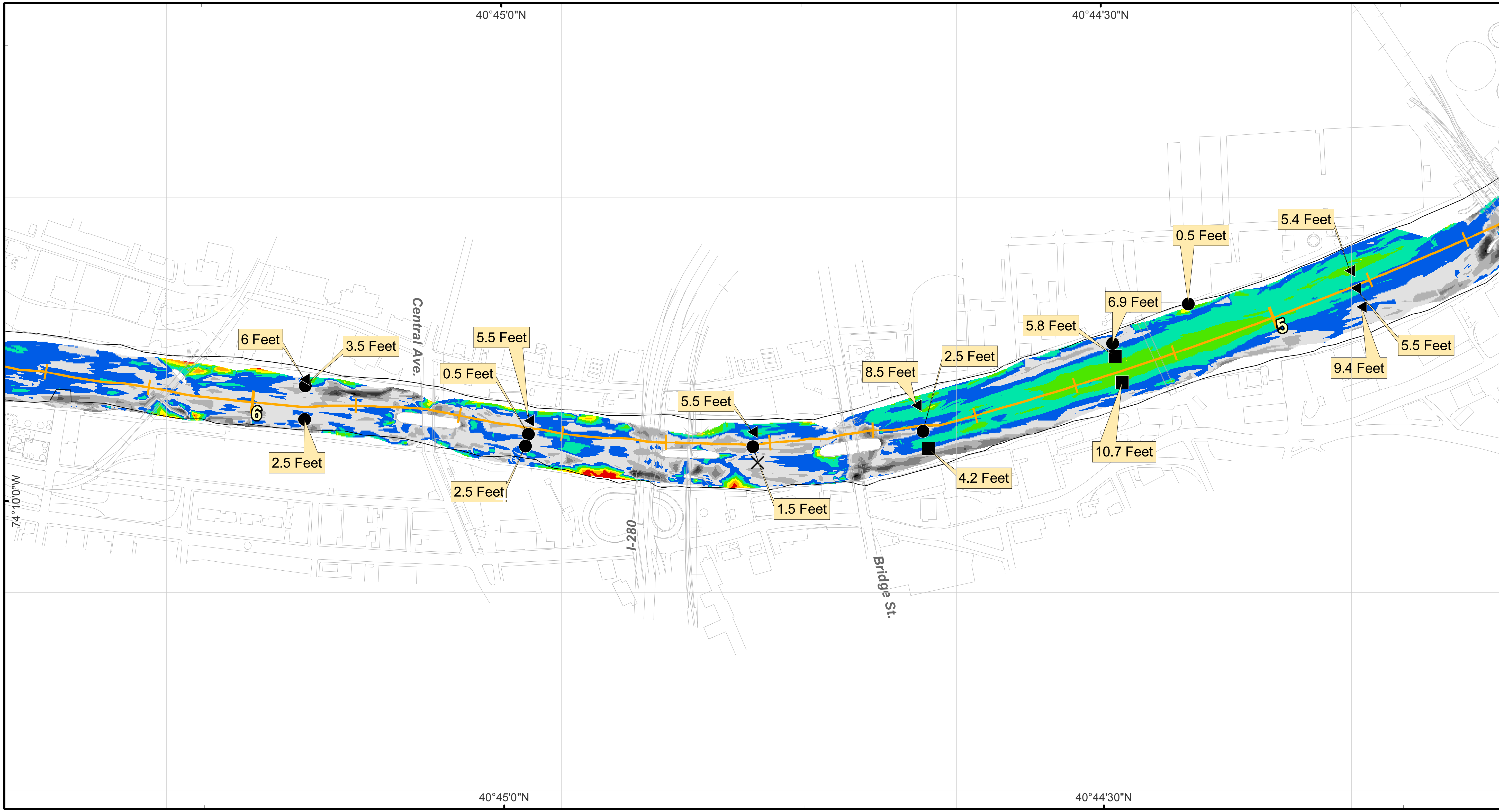

US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River
Restoration Project
New Jersey

**Sedimentation Rate (1989-2004)
& Depth of Total
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Legend

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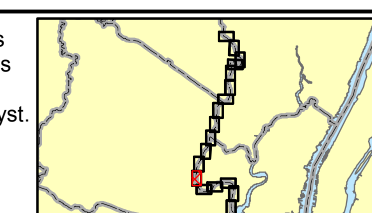

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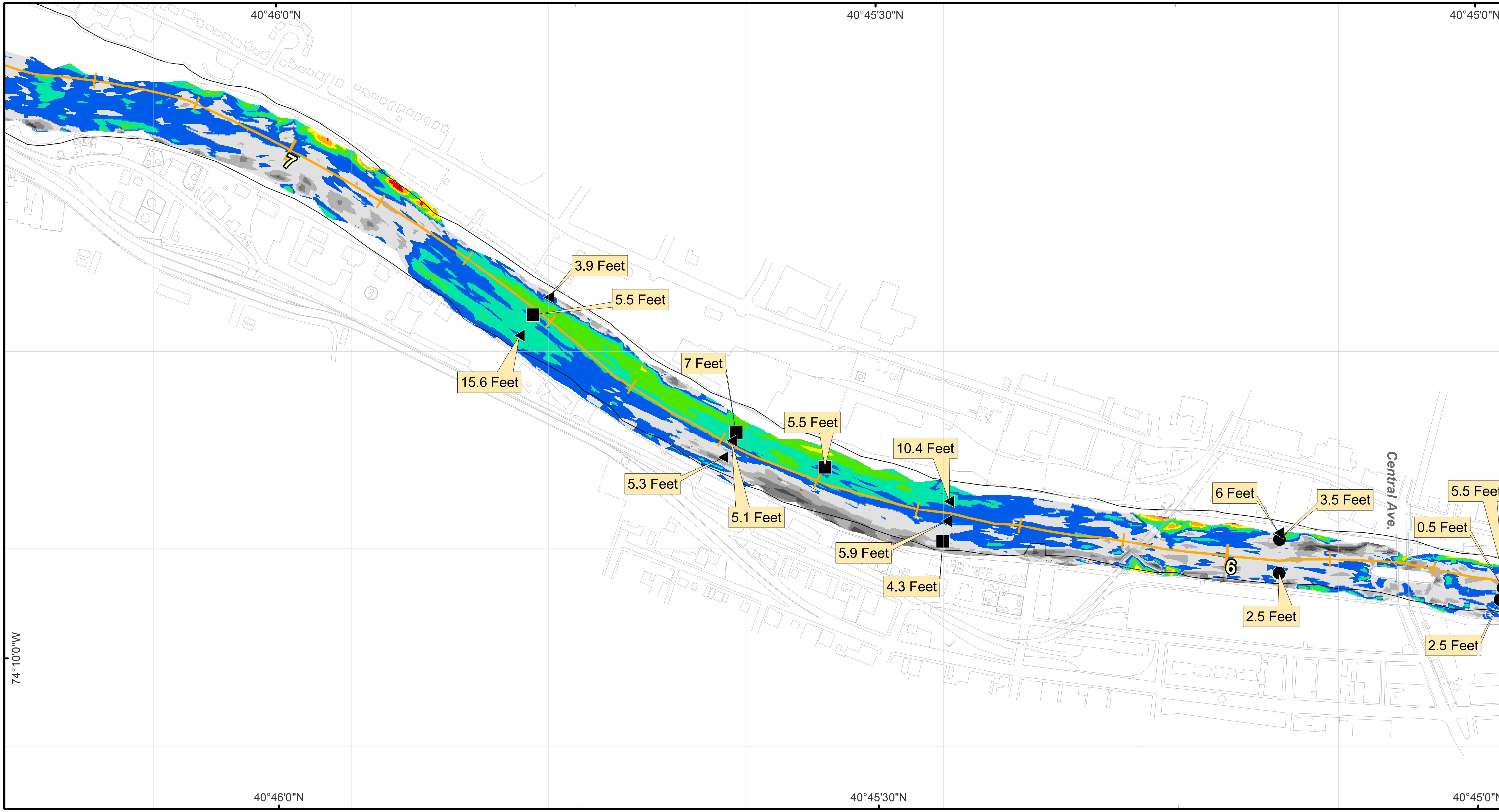

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Lower Passaic River Restoration Project
New Jersey

Sedimentation Rate (1989-2004) & Depth of Total DDT Contamination

Legend

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1 " equals 500 '

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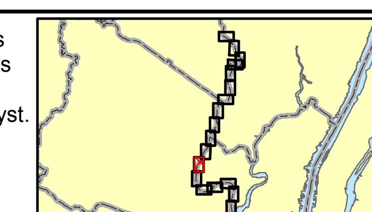
Bathymetric Control Data:
Benchmark: X 71 (NGS PID: KV0256)
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 6 to 7

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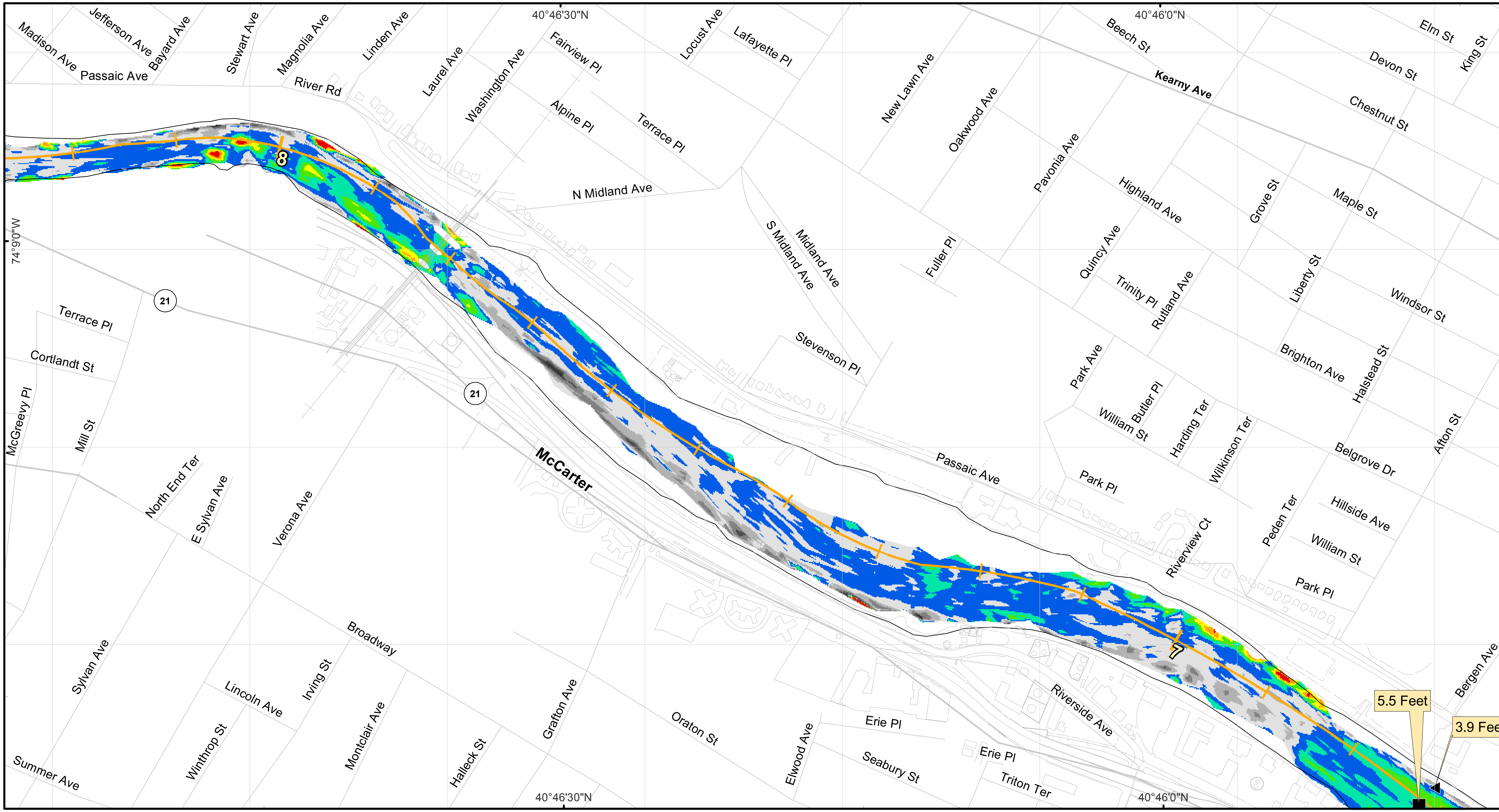

Lower Passaic River Restoration Project
New Jersey

Sedimentation Rate (1989-2004) & Depth of Total DDT Contamination

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Sedimentation Rate
Inches per Year

- < -5
- -5 to -4
- -4 to -3
- -3 to -2
- -2 to -1
- -1 to 0
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- > 5

Total DDT Coring Location

- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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Bathymetric Control Data:
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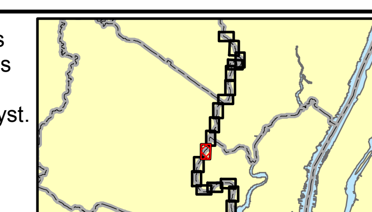
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 7 to 8

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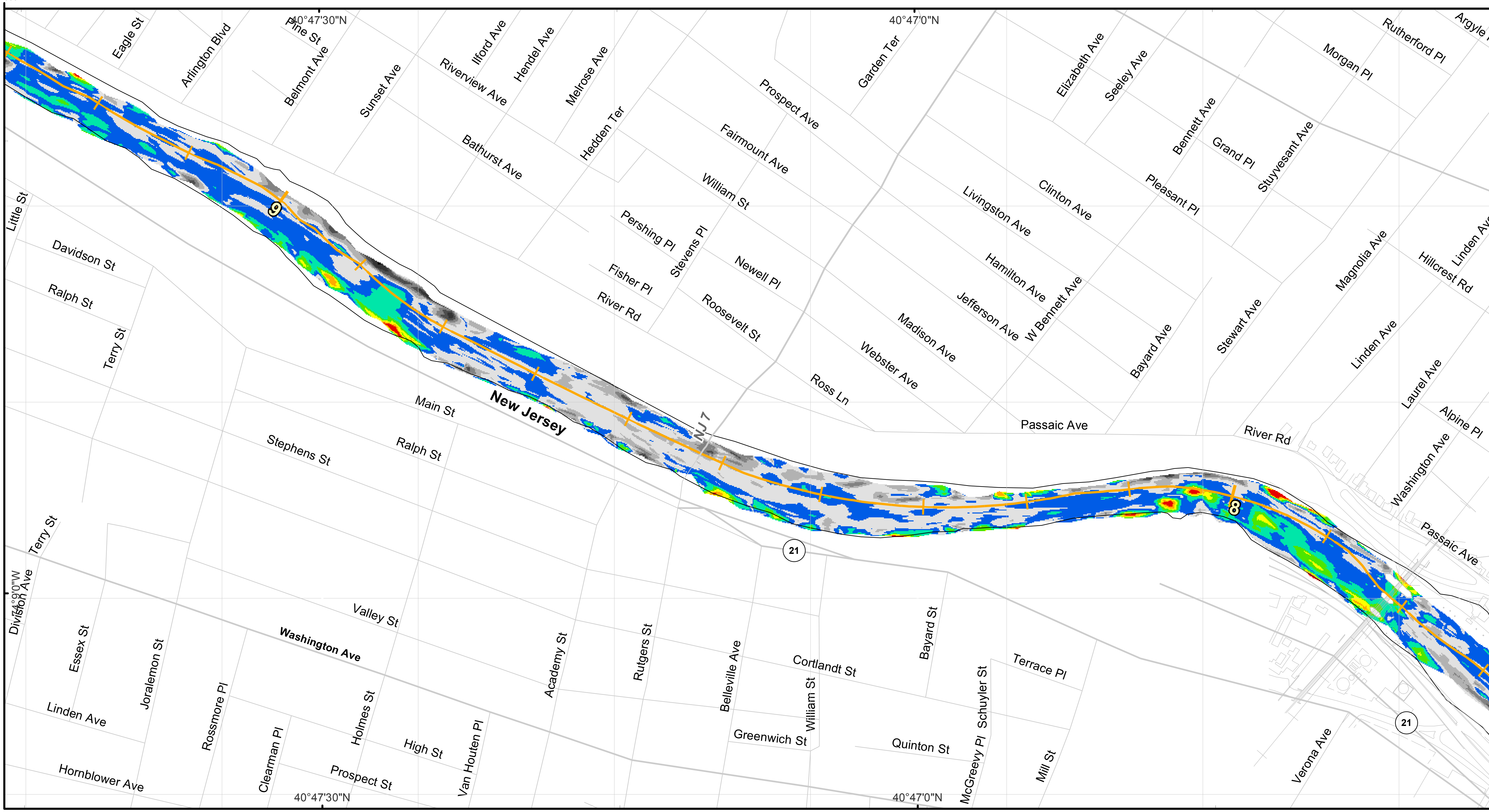

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US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River
Restoration Project
New Jersey
Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

Total DDT Coring Location
- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.
River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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Benchmark: V 71 (NGS PID: KV0254)
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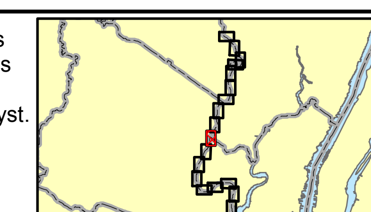
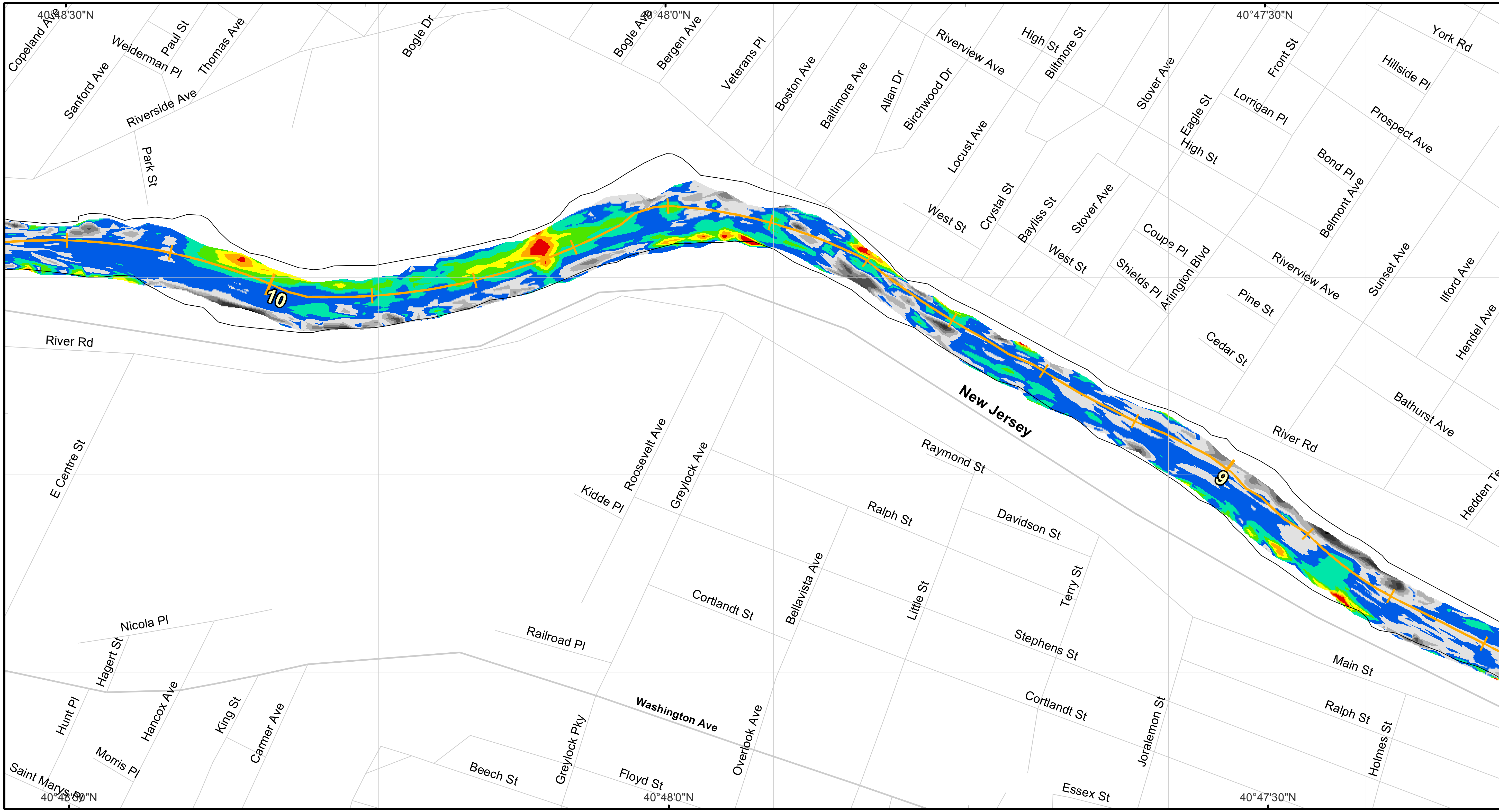


Mile 8 to 9



US Army Corps of Engineers

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Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

Legend

Sedimentation Rate
Inches per Year

- < -5
- -5 to -4
- -4 to -3
- -3 to -2
- -2 to -1
- -1 to 0
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- > 5

Total DDT Coring Location

- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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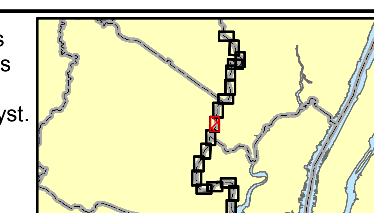
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 9 to 10

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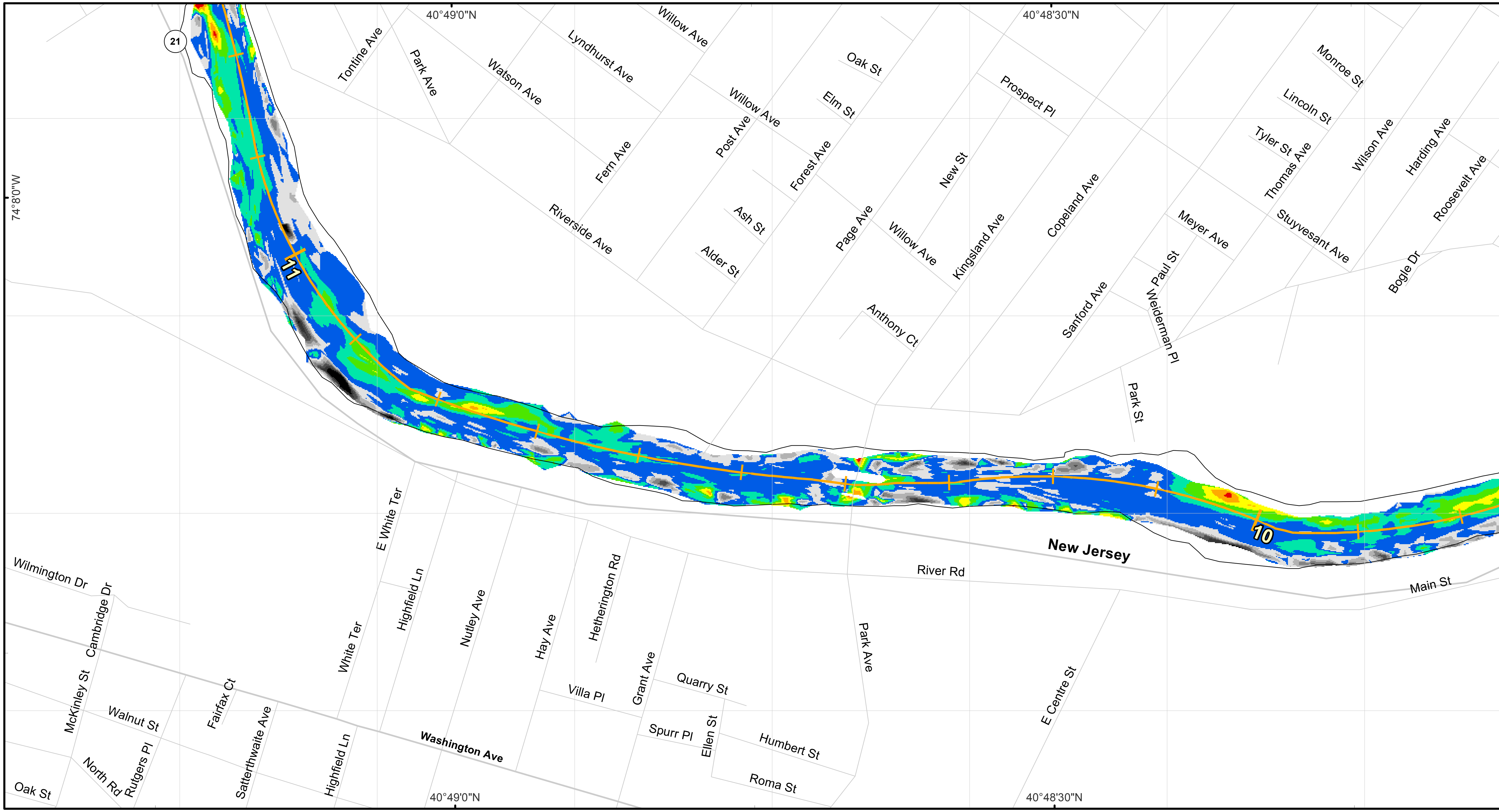

US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

Total DDT Coring Location
- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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Bathymetric Control Data:
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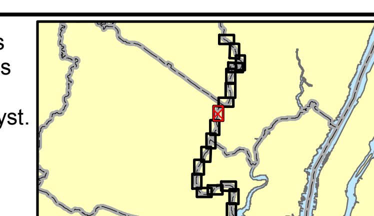
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 10 to 11

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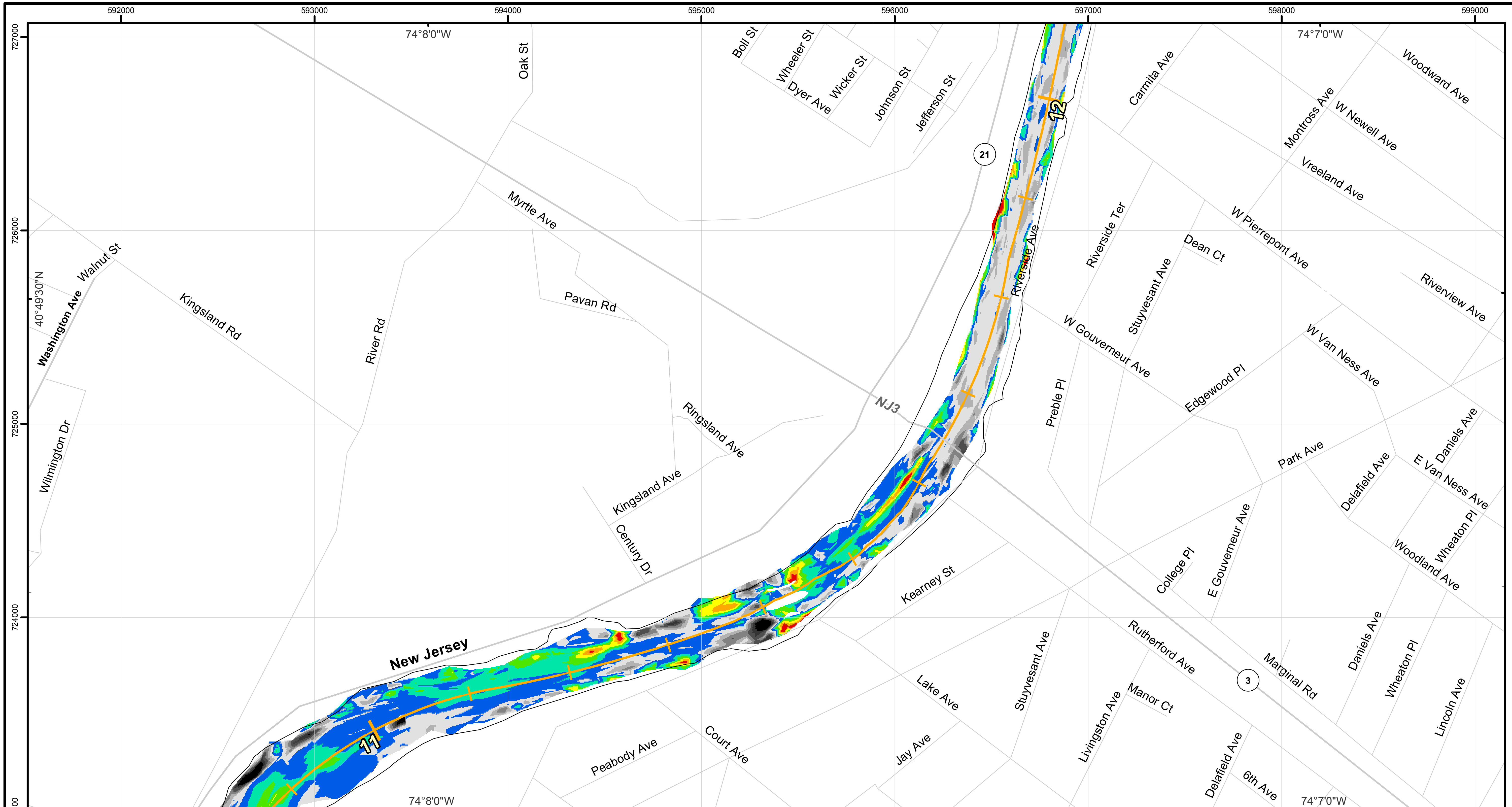

Lower Passaic River
Restoration Project
New Jersey
Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

Total DDT Coring Location
- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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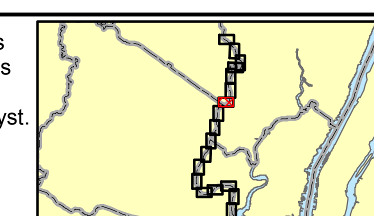
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 11 to 12

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sedimentation_Rate_GeochemEval_November_2005.mxd)
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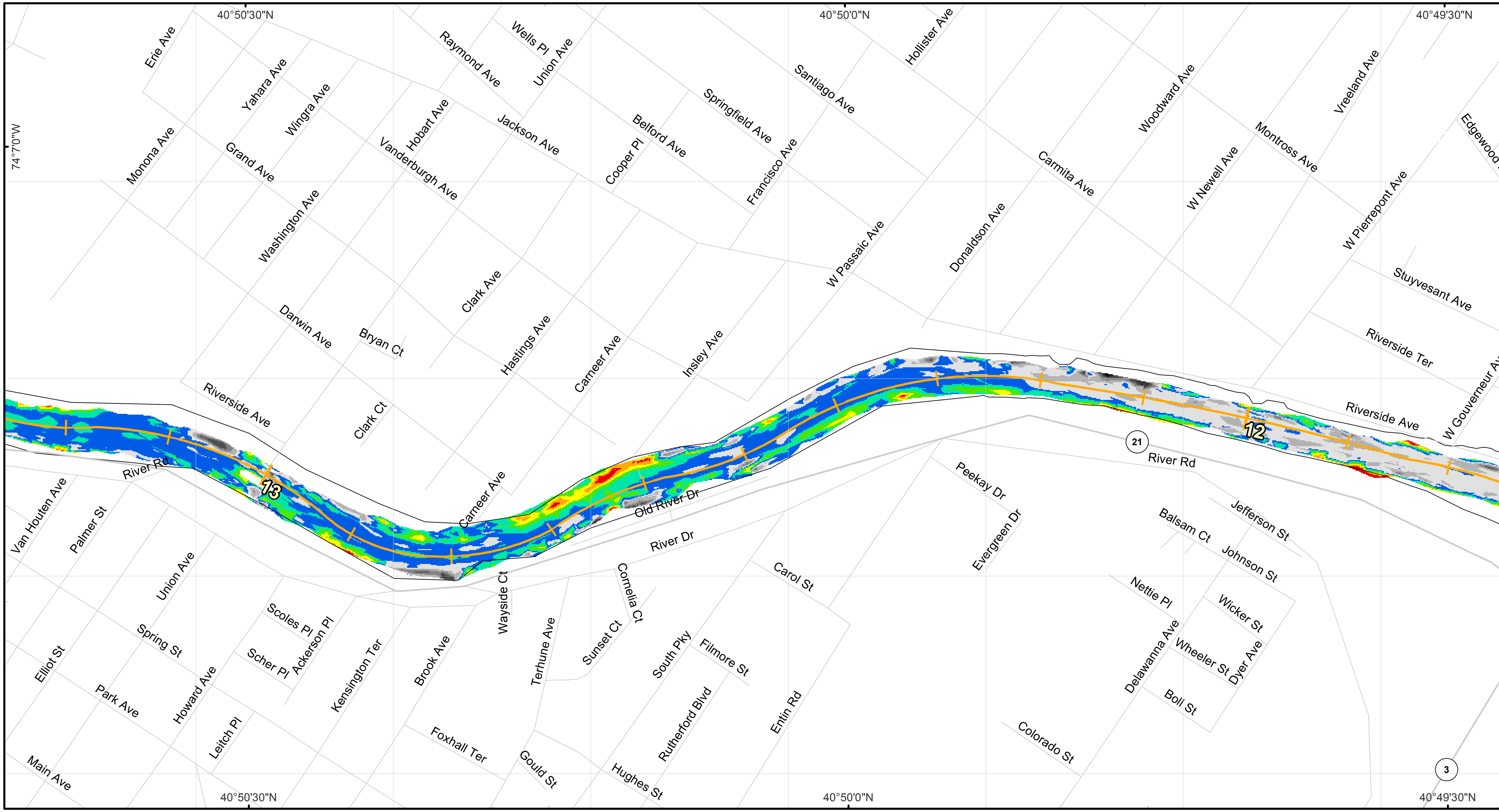

Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Sedimentation Rate
Inches per Year

- < -5
- -5 to -4
- -4 to -3
- -3 to -2
- -2 to -1
- -1 to 0
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- > 5

Total DDT Coring Location

- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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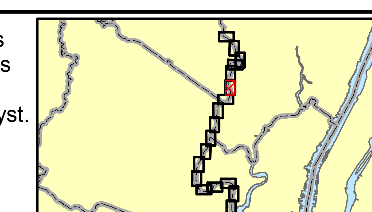
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 12 to 13

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sedimentation_Rate_GeochemEval_November_2005.mxd)
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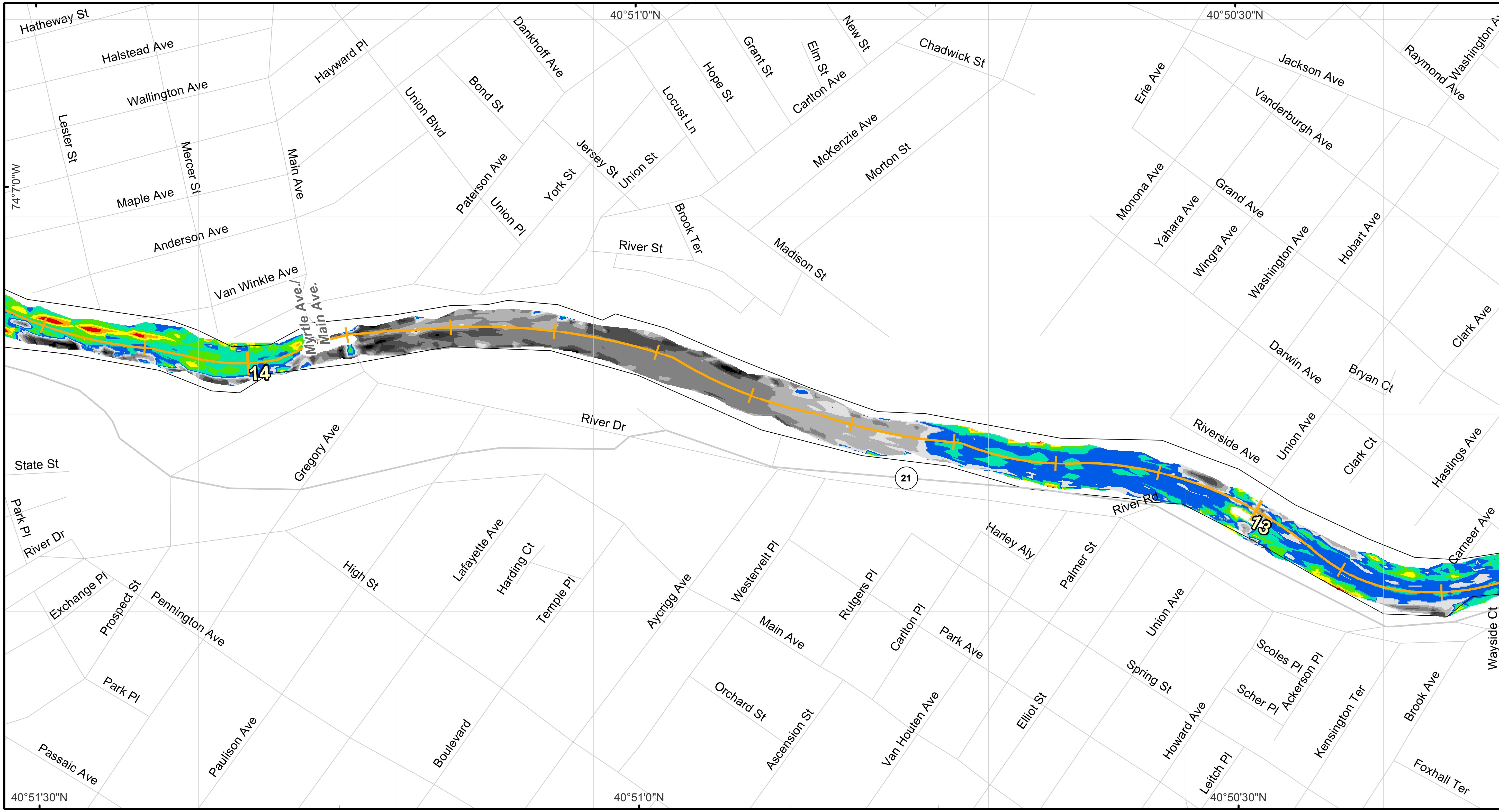

Lower Passaic River
Restoration Project
New Jersey
Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

US Army Corps
of Engineers

MALCOLM
PIRNIE

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

Total DDT Coring Location
- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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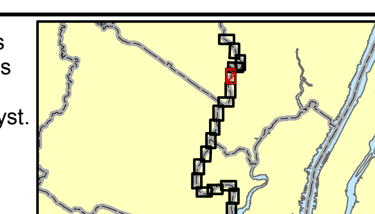
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 13 to 14

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sedimentation_Rate_GeochemEval_November_2005.mxd)
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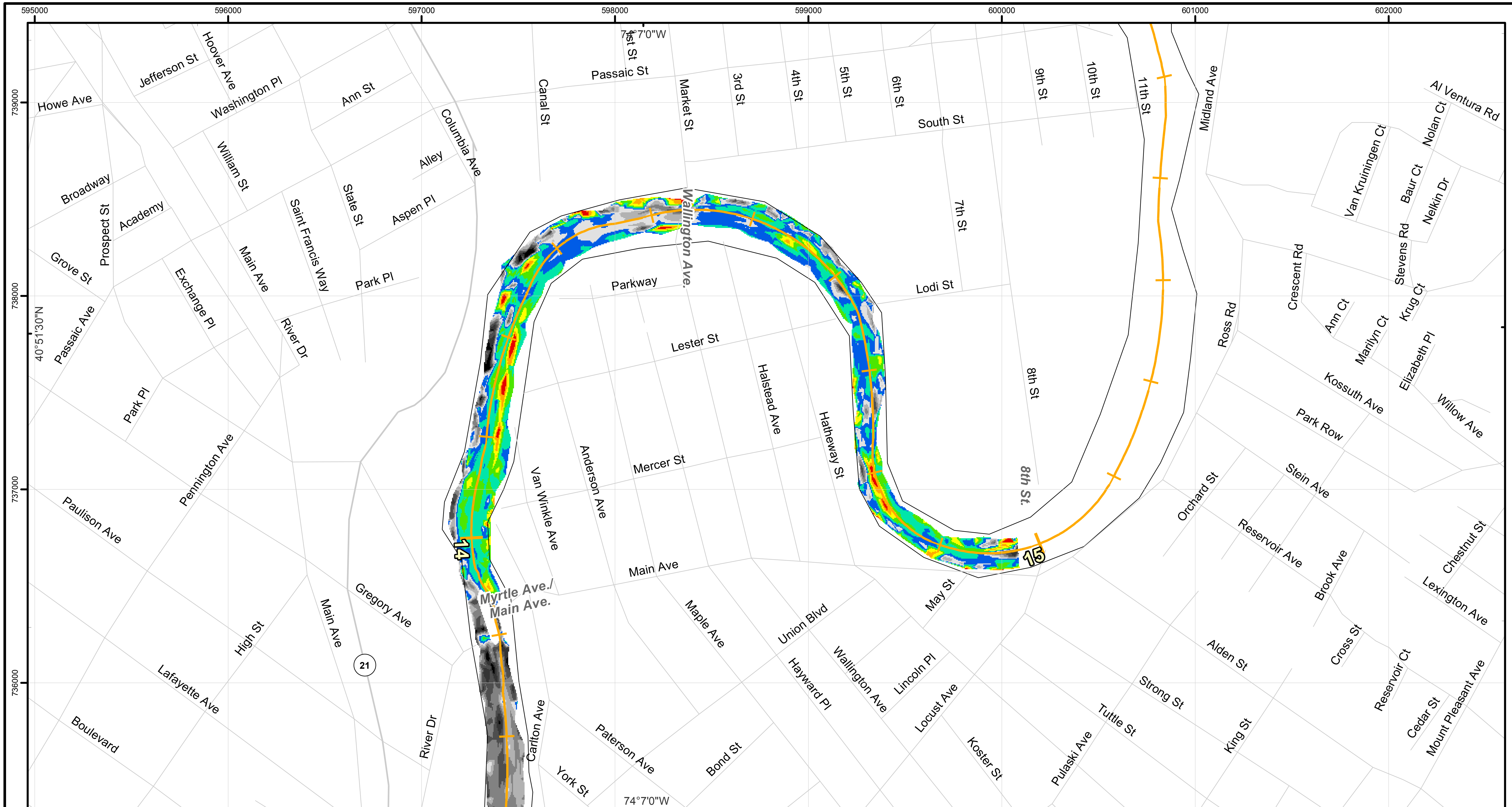

Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

US Army Corps
of Engineers

MALCOLM
PIRNIE

Legend

Sedimentation Rate
Inches per Year

Sedimentation Rate	Sedimentation Rate
< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

Total DDT Coring Location
- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet)
marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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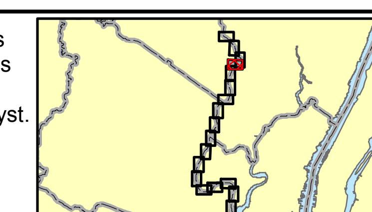
Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 14 to 15

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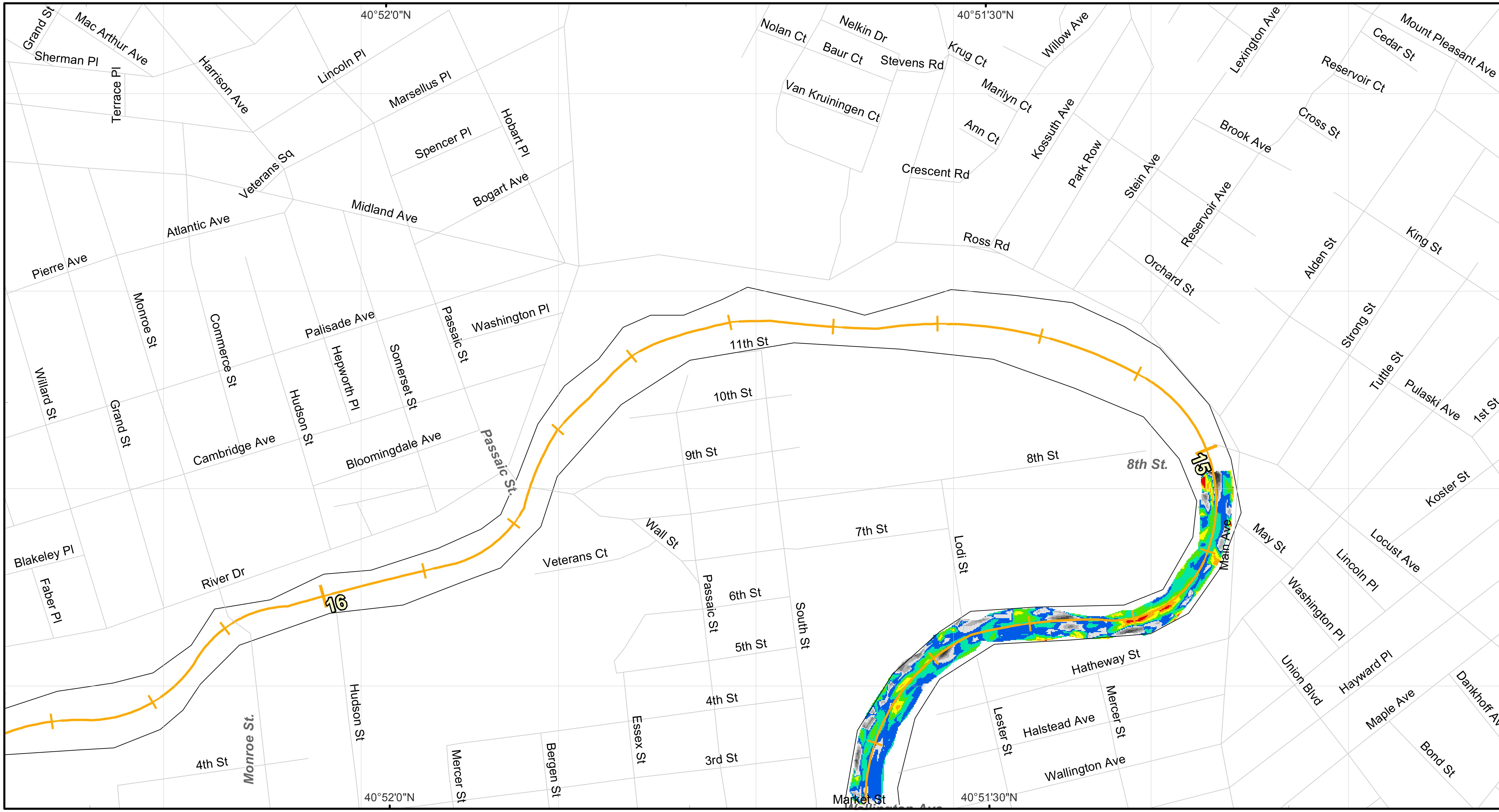

US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate (1989-2004)
& Depth of Total
DDT Contamination

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

Total DDT Coring Location
- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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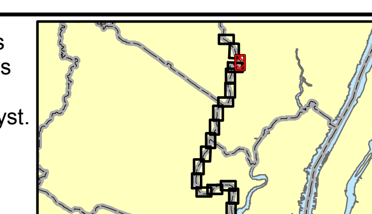
Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 15 to 16

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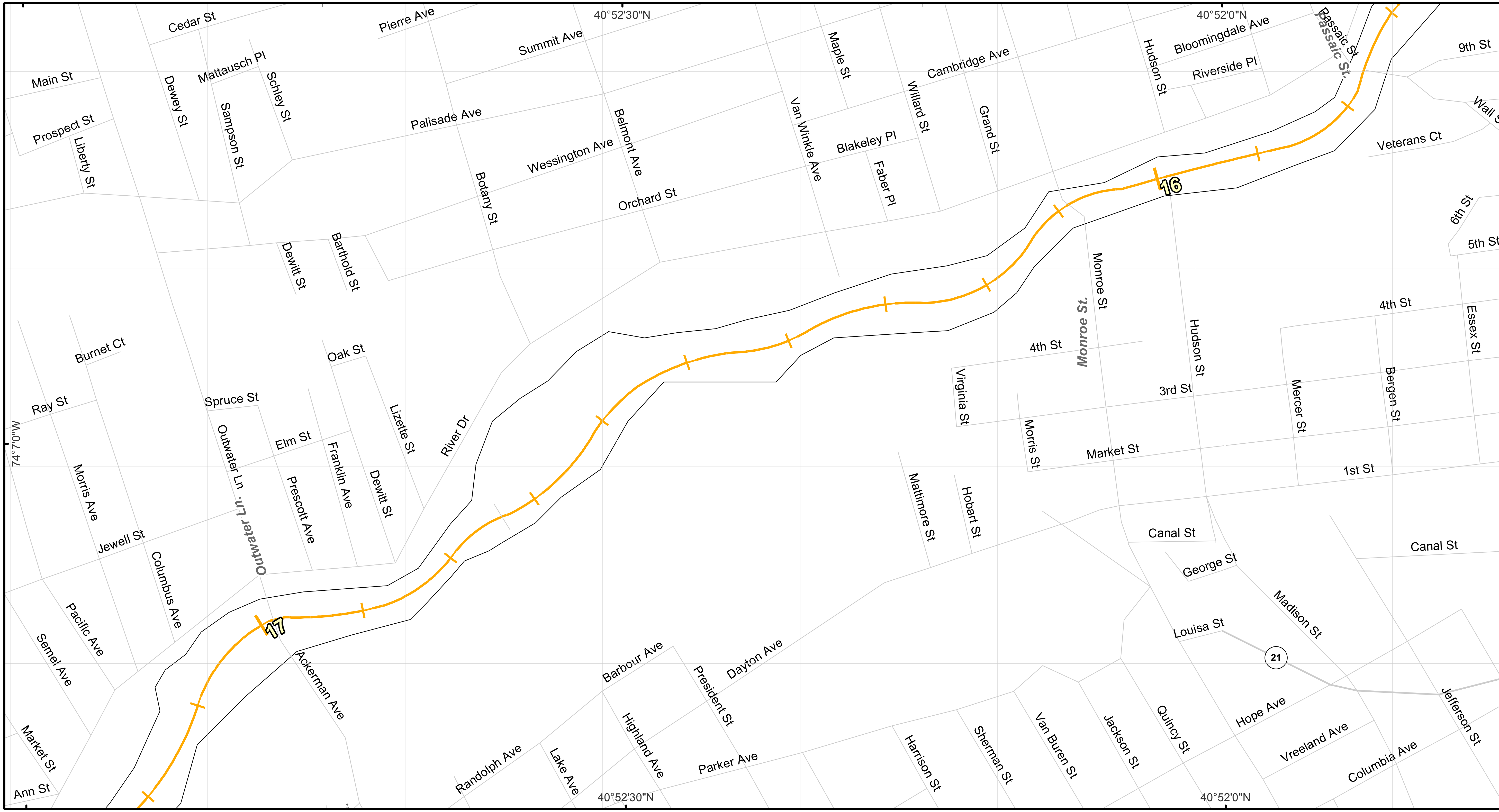

Lower Passaic River Restoration Project
New Jersey
Sedimentation Rate (1989-2004) & Depth of Total DDT Contamination

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Sedimentation Rate
Inches per Year

- < -5
- -5 to -4
- -4 to -3
- -3 to -2
- -2 to -1
- -1 to 0
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- > 5

Total DDT Coring Location

- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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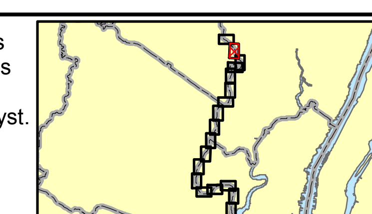
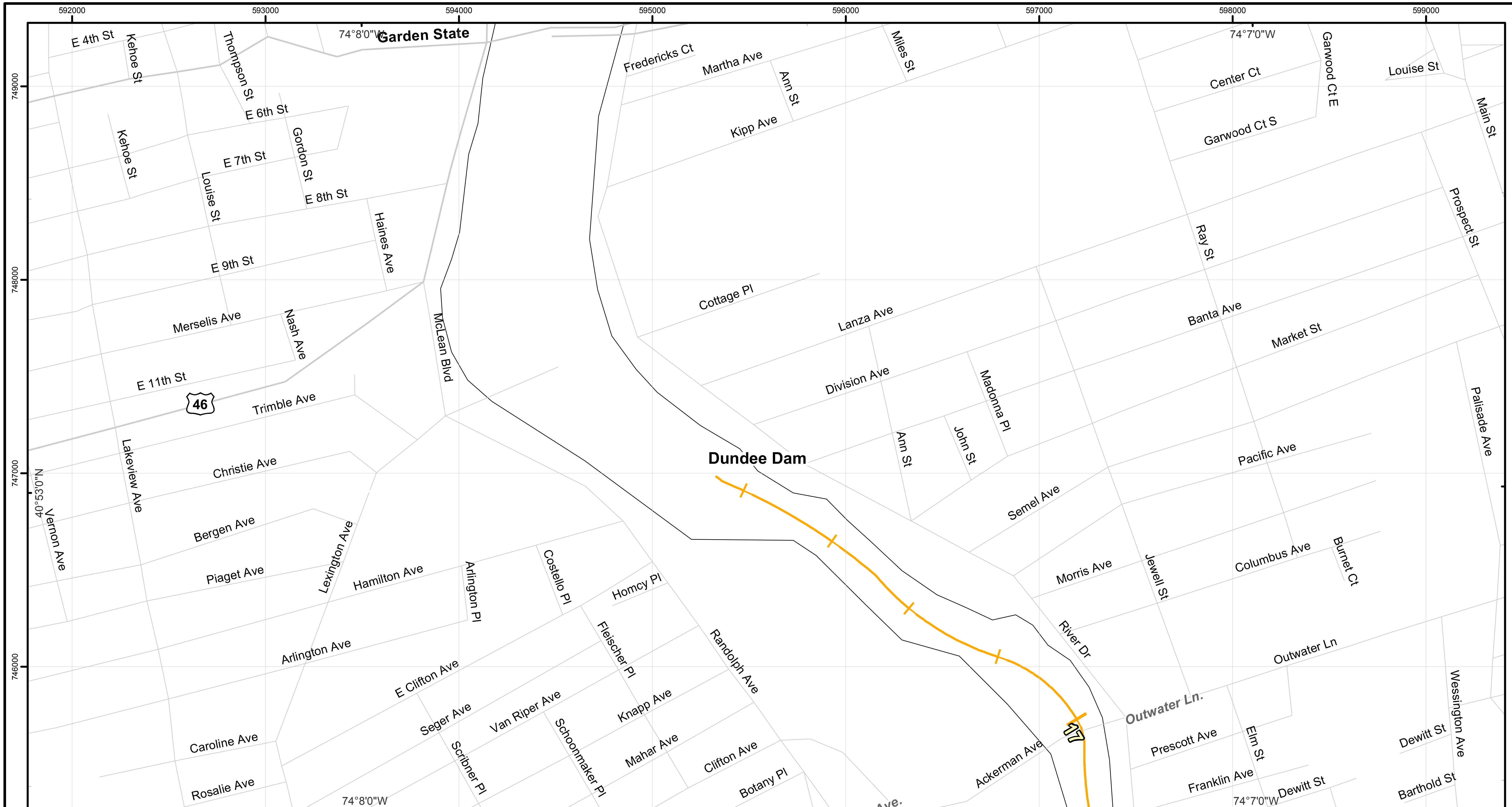
Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 16 to 17



US Army Corps of Engineers

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Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004) & Depth of Total DDT Contamination

Legend

Sedimentation Rate
Inches per Year

- < -5
- -5 to -4
- -4 to -3
- -3 to -2
- -2 to -1
- -1 to 0
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- \> 5

Total DDT Coring Location

- Complete Core
- Incomplete Rising Core
- Incomplete Declining Core
- No Data

Depth of Contamination (Feet) marked in call-out boxes.

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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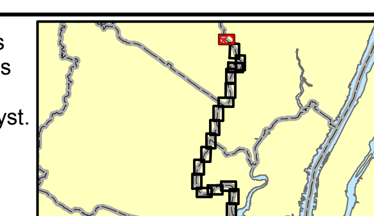
Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 17 to Dundee Dam

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sedimentation_Rate_GeochemEval_November_2005.mxd)
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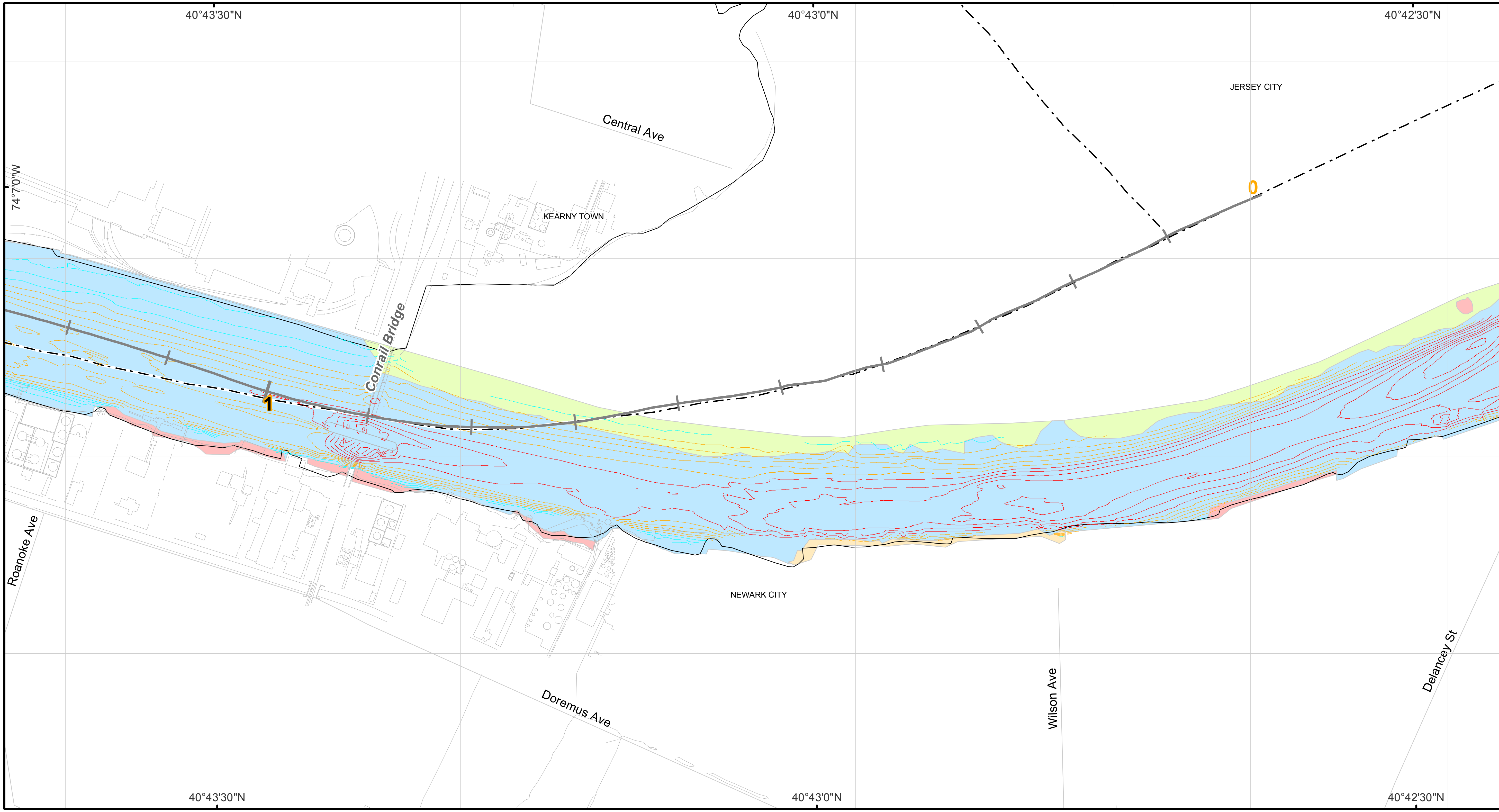
Attachment 2: Surficial Sediment Texture

One-mile-per-plate map book containing (1) surficial sediment texture as interpreted by Aqua Survey, Inc. during their June 2005 geophysical survey [refer to the Draft Technical Report: Geophysical Survey (Aqua Survey, Inc., 2005) for more information] and (2) the 2004 USACE bathymetric survey displayed as elevation (feet) relative to NGVD29. Note that the sediment texture data extend to RM 16.1 and the elevation data extend to the Dundee Dam at RM 17.4.



Lower Passaic River
Restoration Project
New Jersey

US Army Corps of Engineers

MALCOLM PIRNIE

Sediment Texture Map

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

- -30 to -20
- -18 to -10
- -8 to 0
- 2 to 10

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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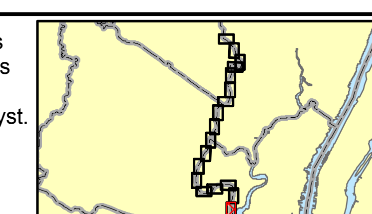
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 0 to 1

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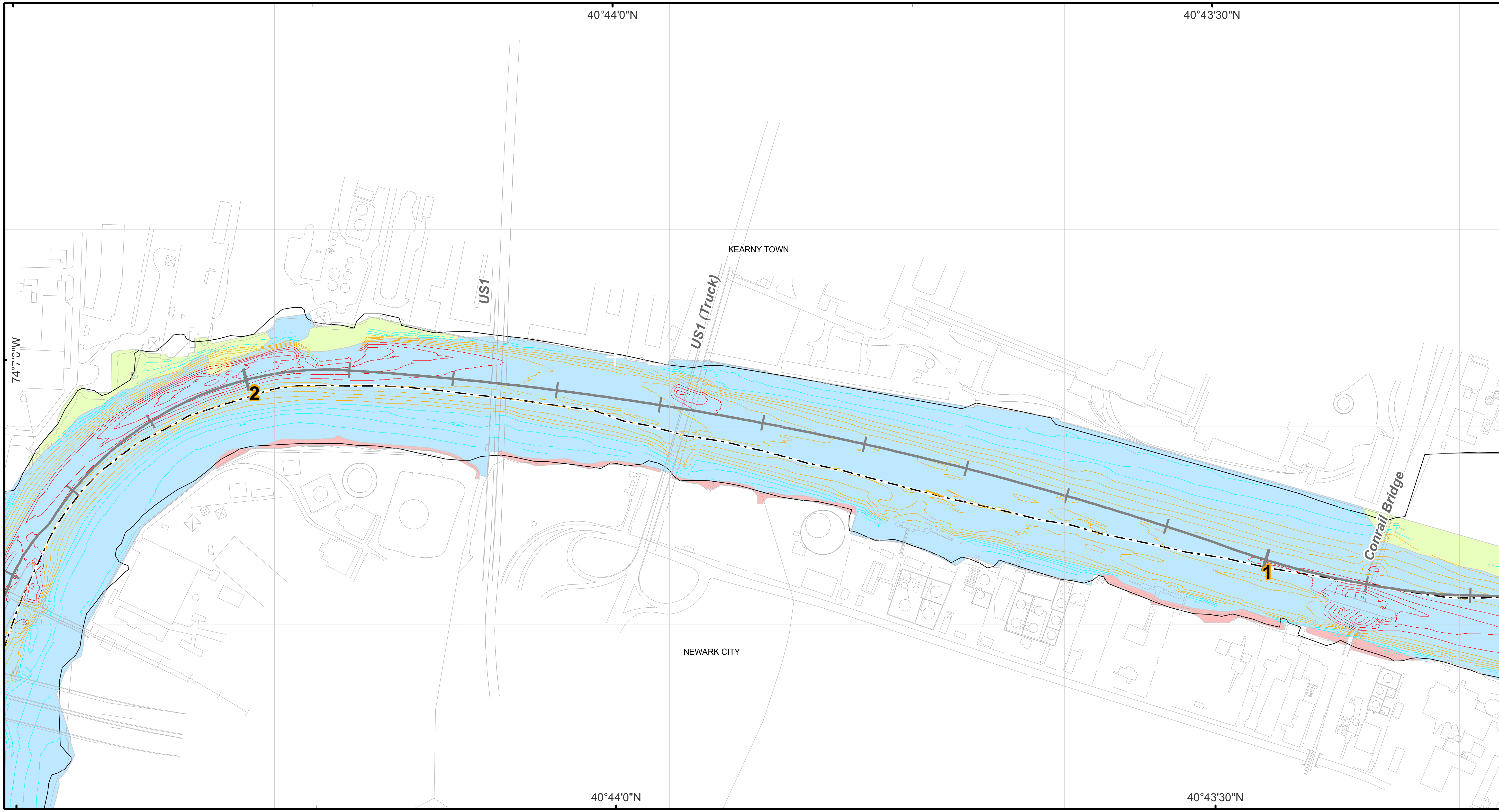


Lower Passaic River Restoration Project New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

- -30 to -20
- -18 to -10
- -8 to 0
- 2 to 10

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

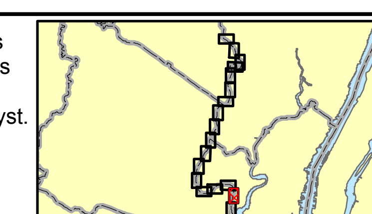
0 250 500 1,000

1 " equals 500 '

A Triangulated Irregular Network (TIN) was derived from the survey points using ESRI's 3-D Analyst in ArcGIS. Contours were interpolated from the TIN, also in 3-D Analyst.

Bathymetric Control Data:
Benchmark: X 71 (NGS PID: KV0256)
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 1 to 2

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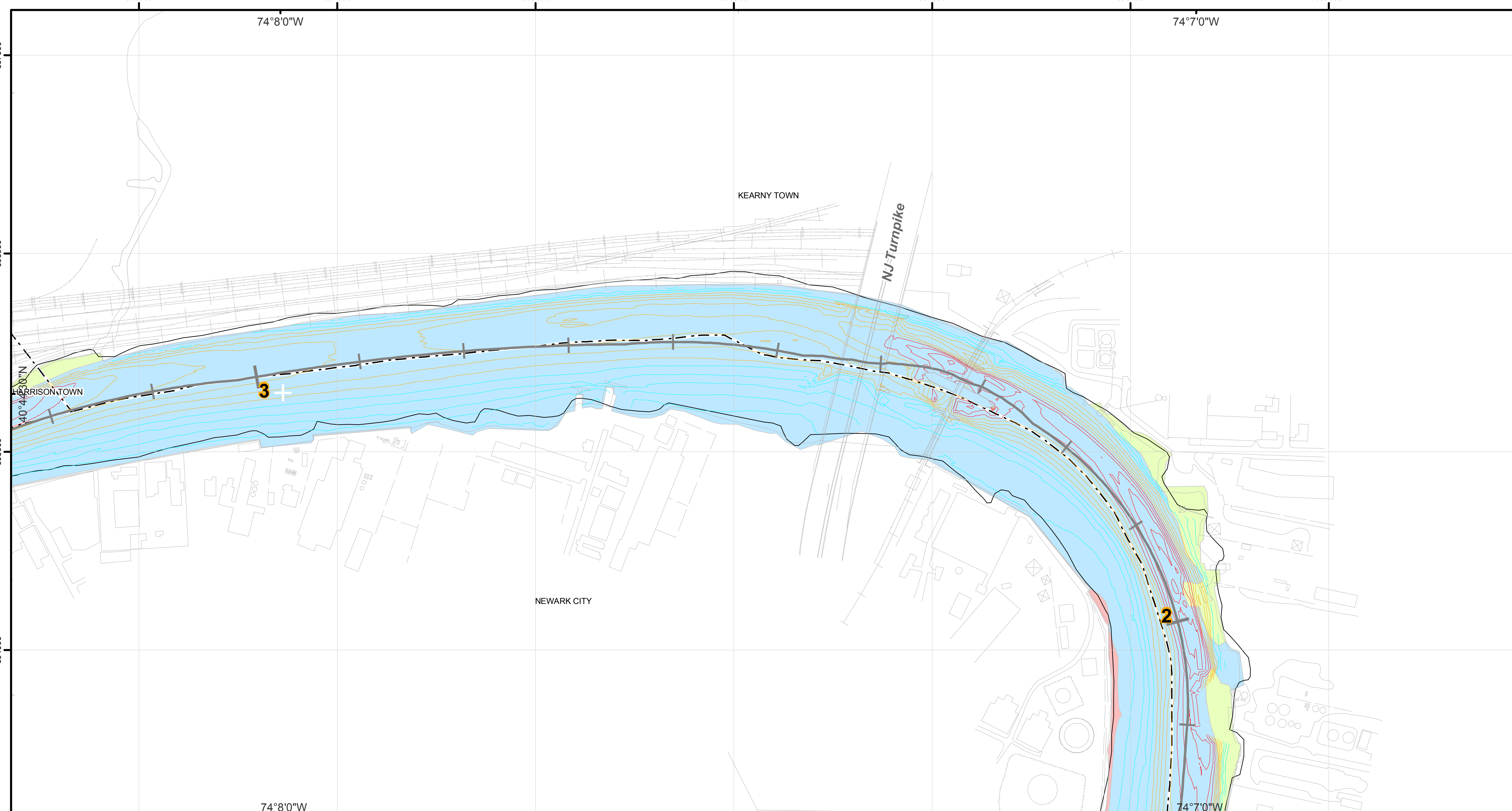

Lower Passaic River Restoration Project New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

- -30 to -20
- -18 to -10
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Coordinate System: State Plane New Jersey
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Units: Feet

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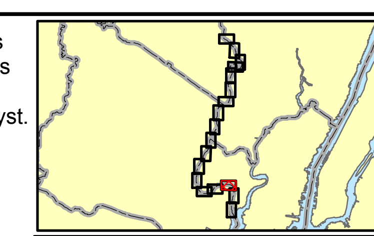

Mile 2 to 3

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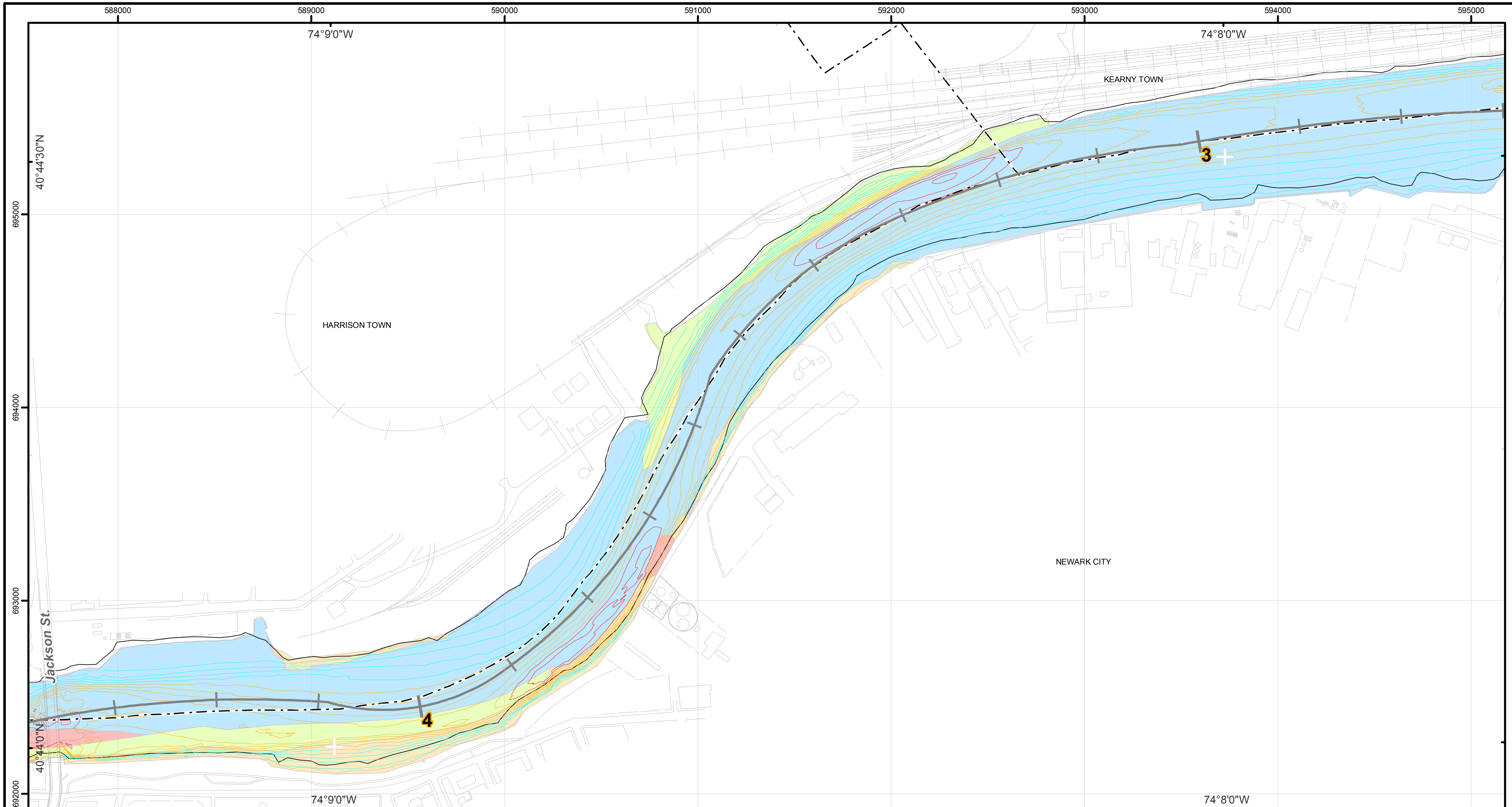

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US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River
Restoration Project
New Jersey

Sediment Texture Map

__Legend__

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet)
Relative to NGVD29

- -30 to -20
- -18 to -10
- -8 to 0
- 2 to 10

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

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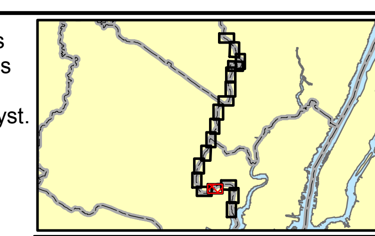
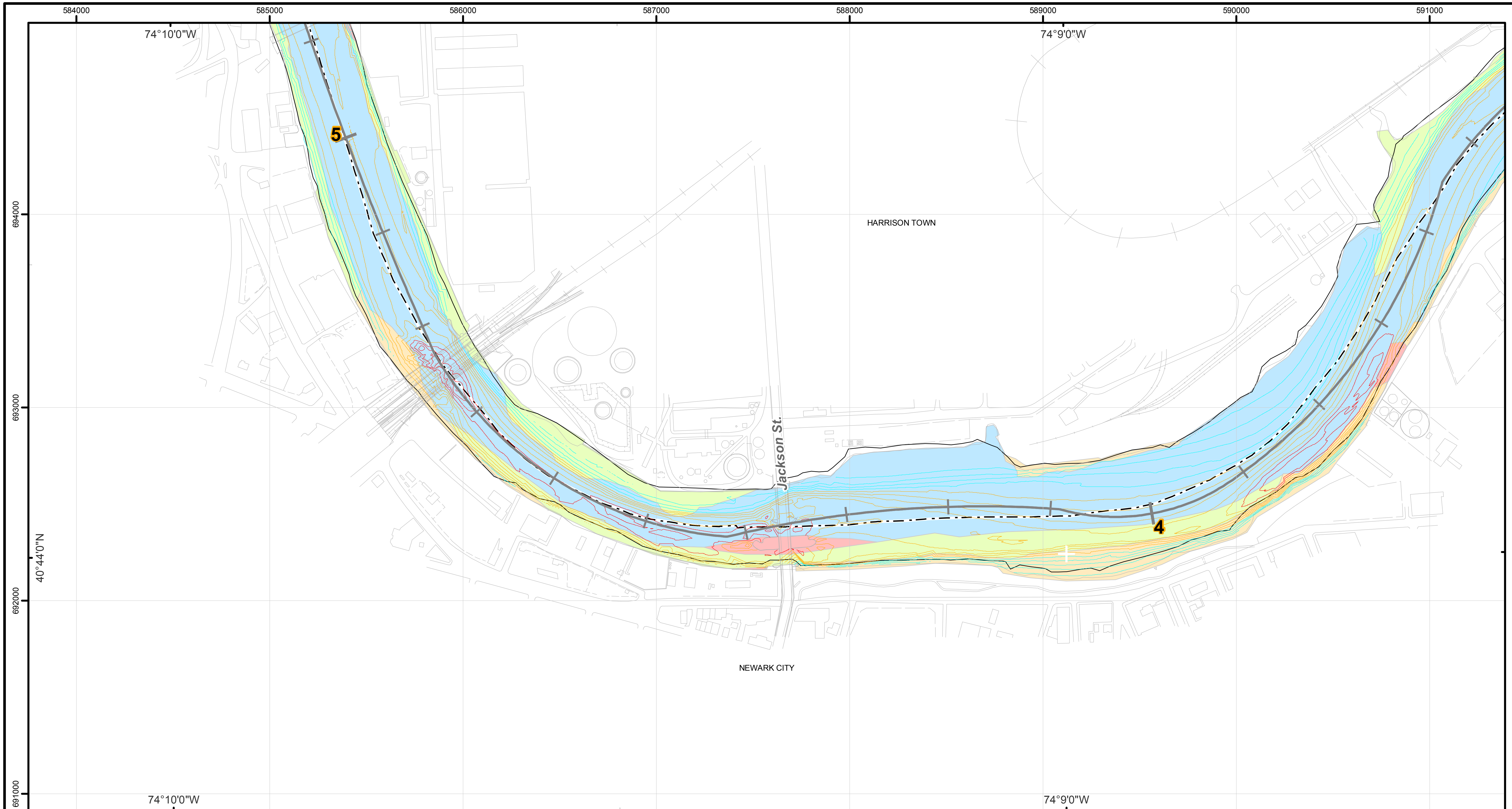


Mile 3 to 4



Lower Passaic River
Restoration Project
New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
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- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

-30 to -20
-18 to -10
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2 to 10

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N

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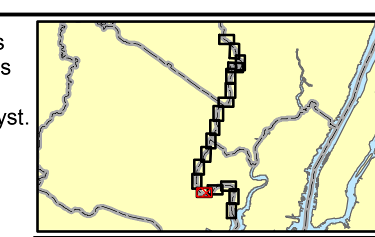

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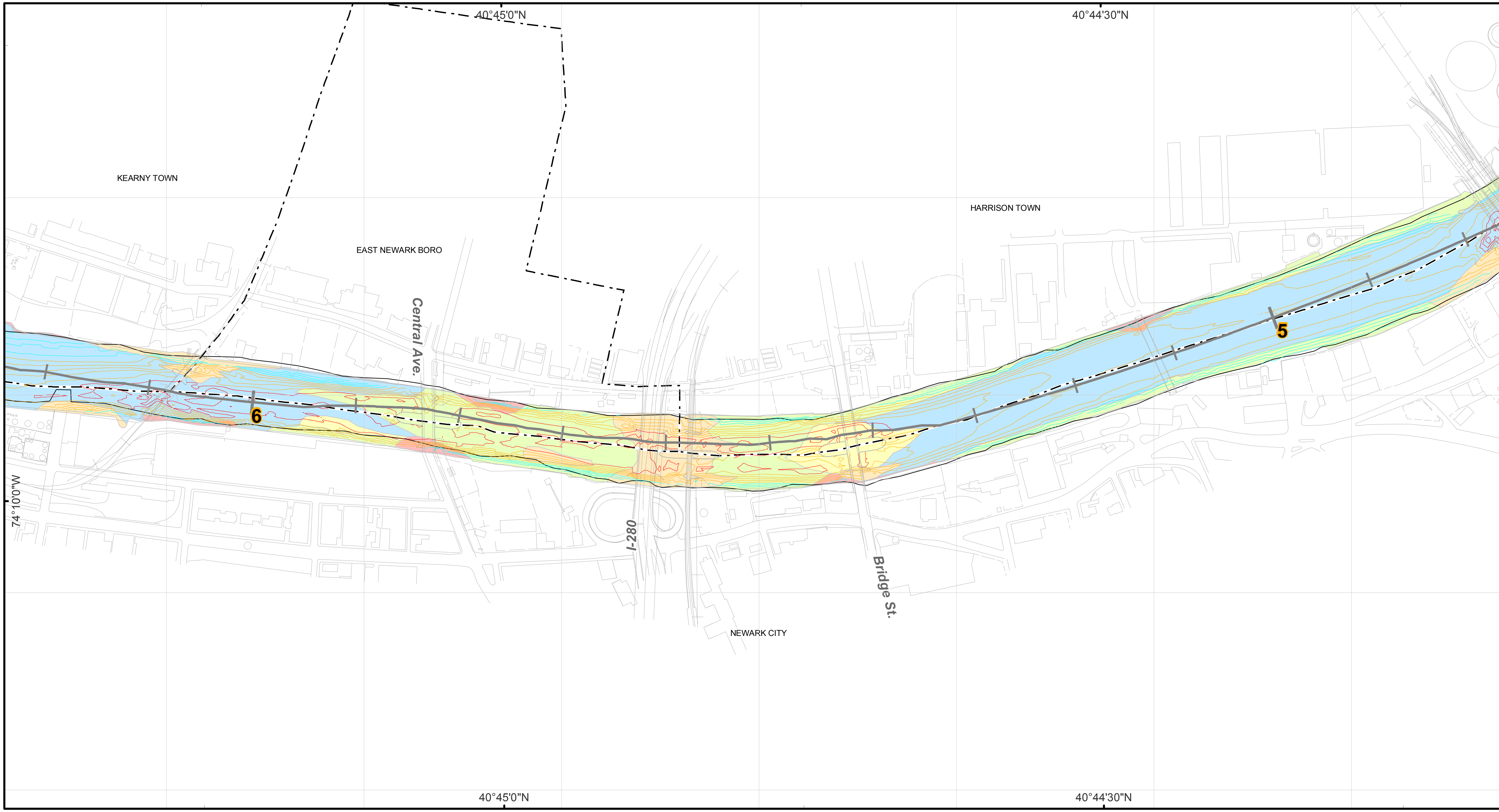

US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project New Jersey

Sediment Texture Map

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

- -30 to -20
- -18 to -10
- -8 to 0
- 2 to 10

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

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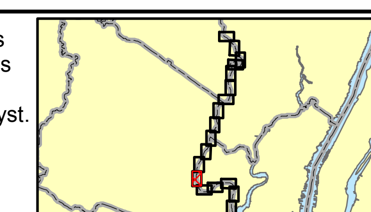
Elevation: 15.76 FEET (NGVD 29)



Mile 5 to 6

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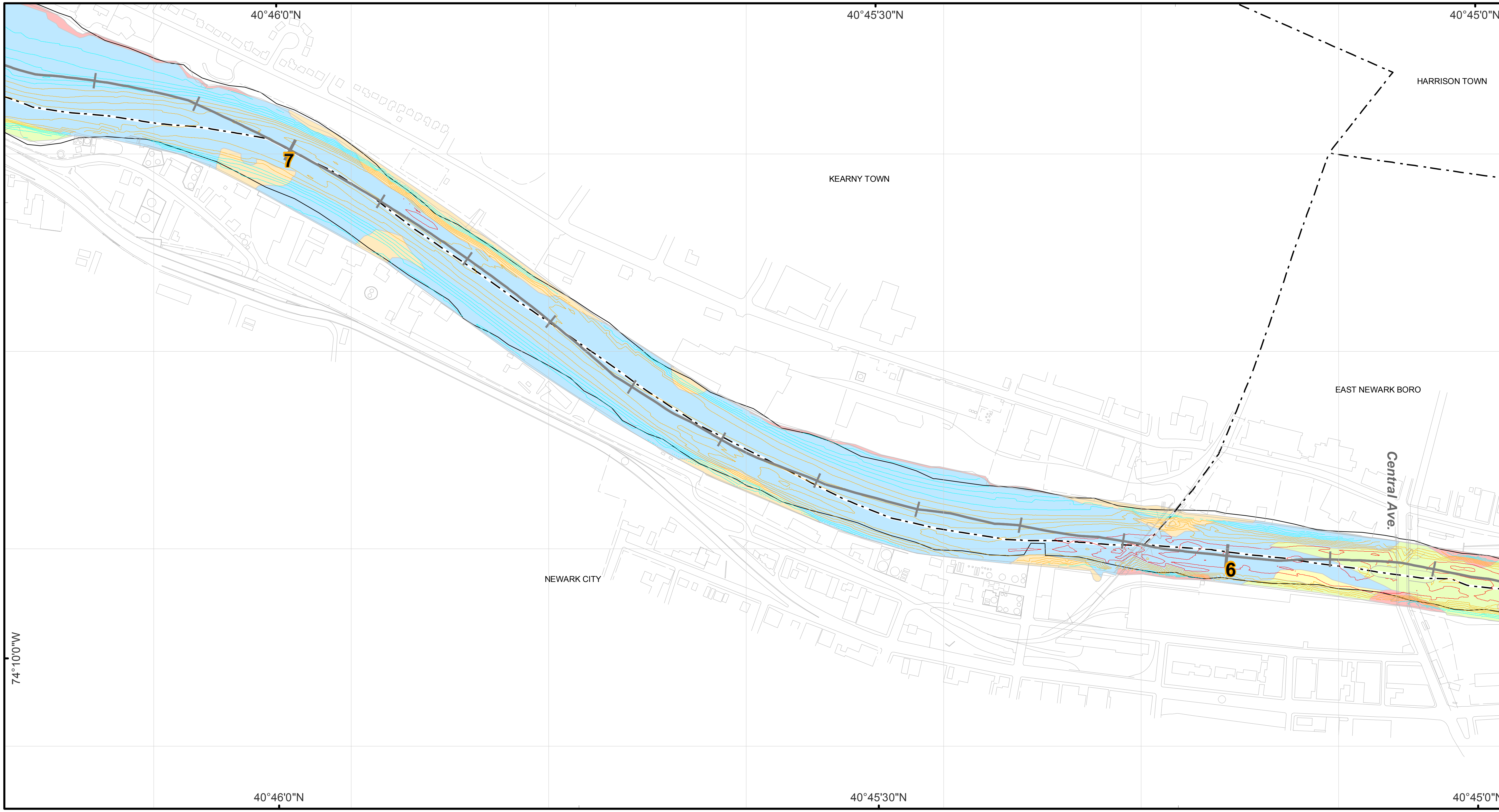

Lower Passaic River
Restoration Project
New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

- -30 to -20
- -18 to -10
- -8 to 0
- 2 to 10

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

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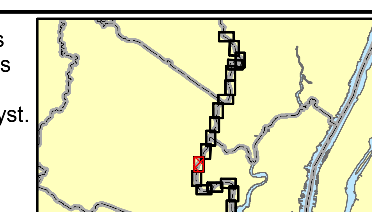
Elevation: 15.76 FEET (NGVD 29)



Mile 6 to 7

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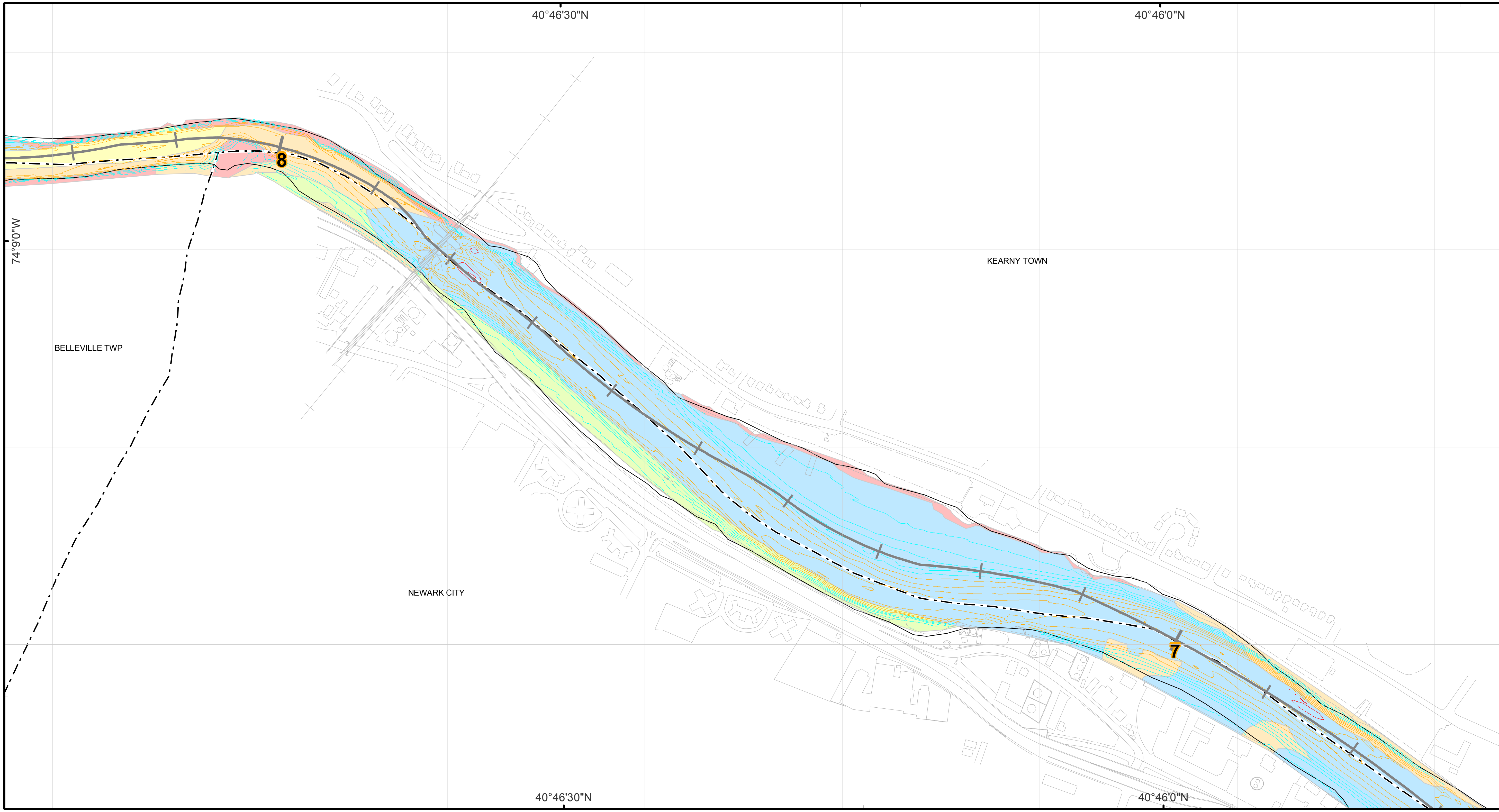

US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project New Jersey

Sediment Texture Map

Legend

Rock and Coarse gravel	2004 USACE Bathymetric Survey
Gravel and Sand	
Sand	Elevation (Feet) Relative to NGVD29
Silt and Sand	-30 to -20 / -8 to 0
Silt	-18 to -10 / 2 to 10
River Mile Post	

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

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Benchmark: V 71 (NGS PID: KV0254)
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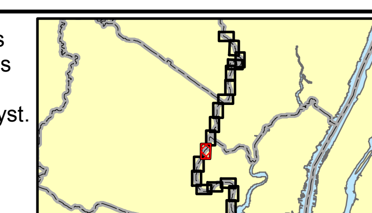

Mile 7 to 8

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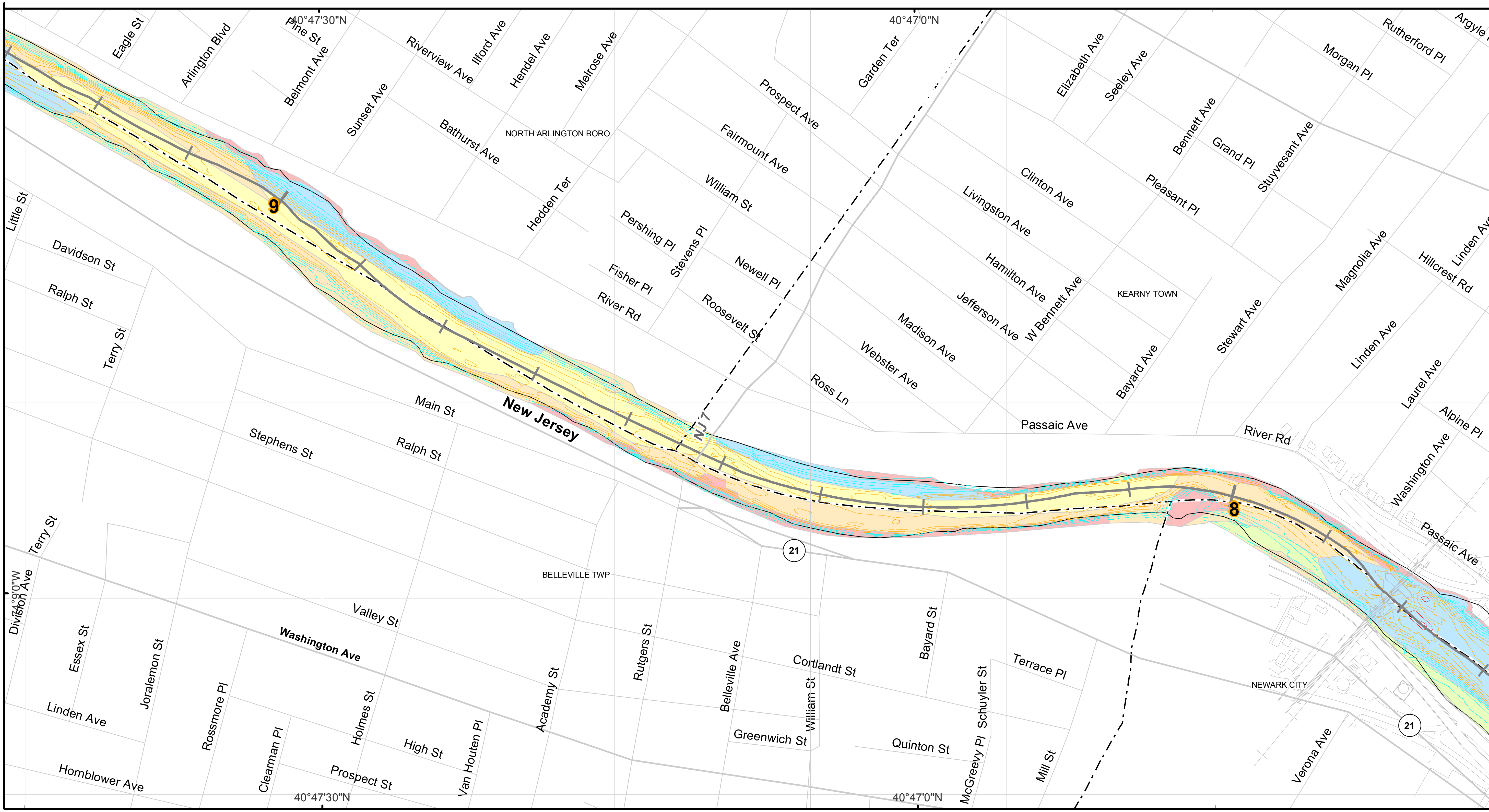

Lower Passaic River Restoration Project
New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

- -30 to -20
- -18 to -10
- -8 to 0
- 2 to 10

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

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Benchmark: V 71 (NGS PID: KV0254)
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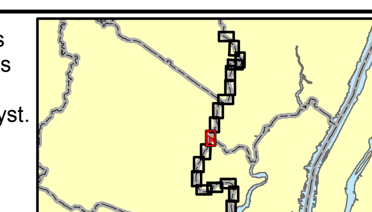

Mile 8 to 9

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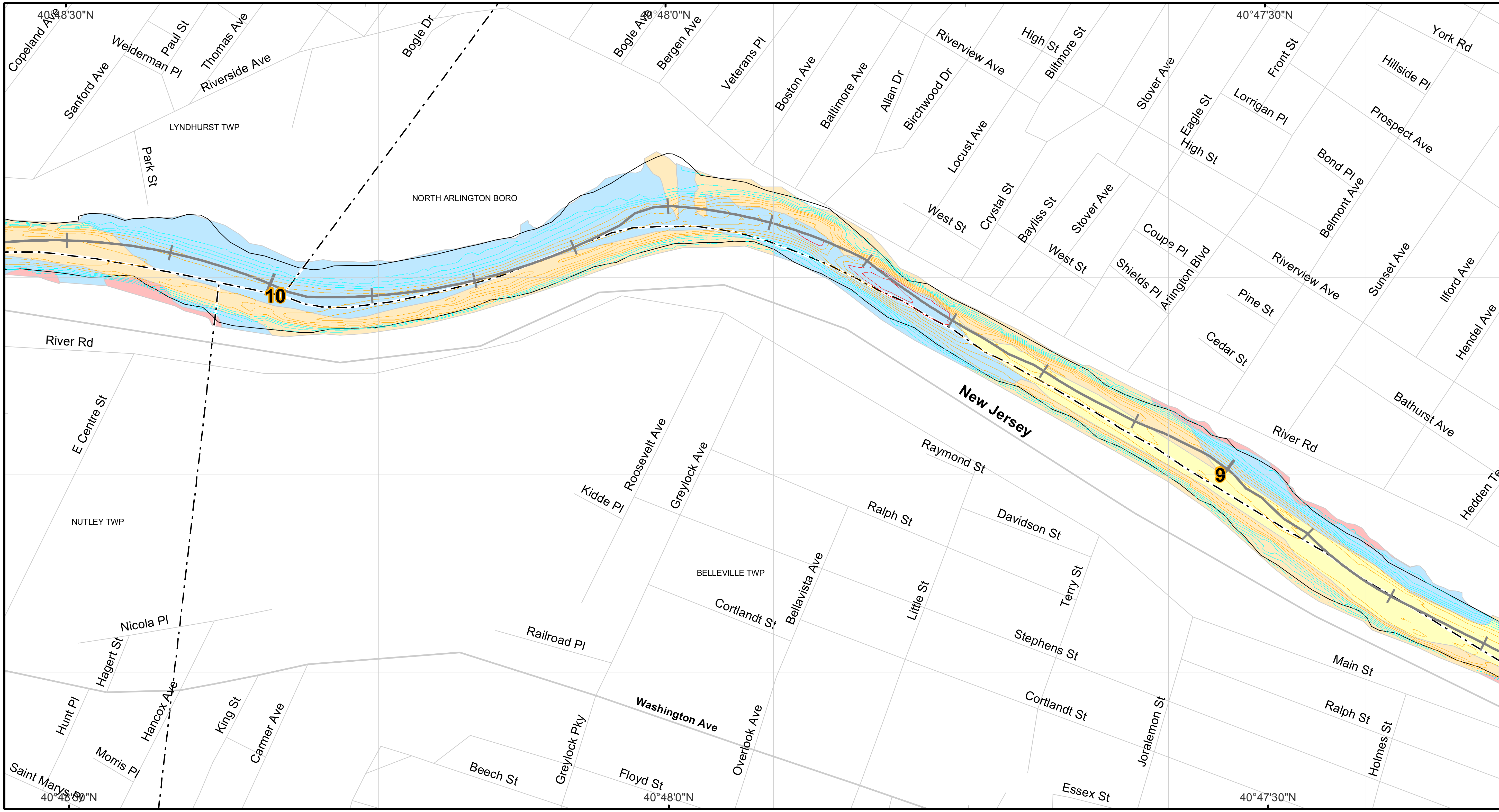

US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project New Jersey

Sediment Texture Map

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

- -30 to -20
- -18 to -10
- -8 to 0
- 2 to 10

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

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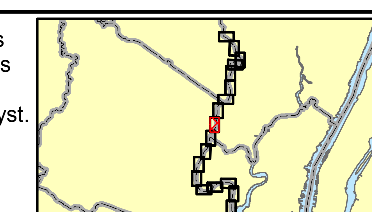

Mile 9 to 10

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sediment_Texture_Geophysical_Memo_October_2005.mxd)
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Lower Passaic River Restoration Project
New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Rock and Coarse gravel
Gravel and Sand
Sand
Silt and Sand
Silt
River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29
-30 to -20
-18 to -10
-8 to 0
2 to 10

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Datum: NAD 83
Units: Feet

N

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Mile 10 to 11

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sediment_Texture_Geophysical_Memo_October_2005.mxd)
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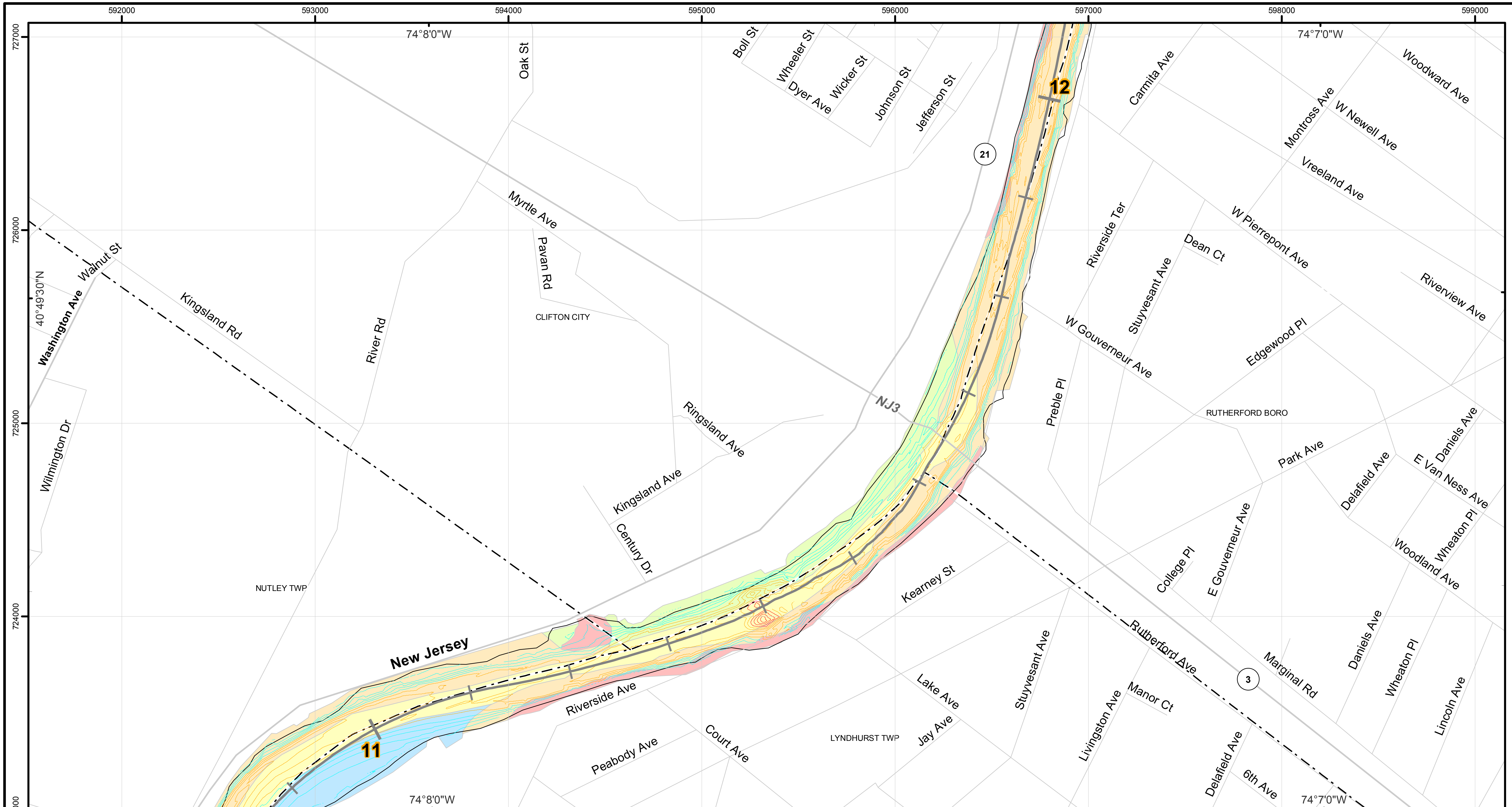

Lower Passaic River
Restoration Project
New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
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- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

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Coordinate System: State Plane New Jersey
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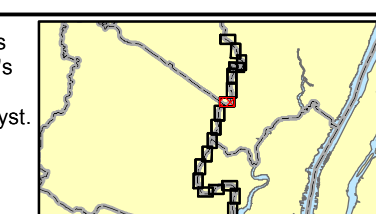

Mile 11 to 12

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sediment_Texture_Geophysical_Memo_October_2005.mxd)
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Lower Passaic River Restoration Project New Jersey

Sediment Texture Map

Legend

- Rock and Coarse gravel
- Gravel and Sand
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- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

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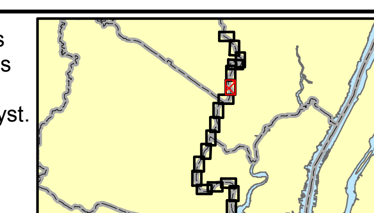
Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 12 to 13

US Army Corps of Engineers

MALCOLM PIRNIE

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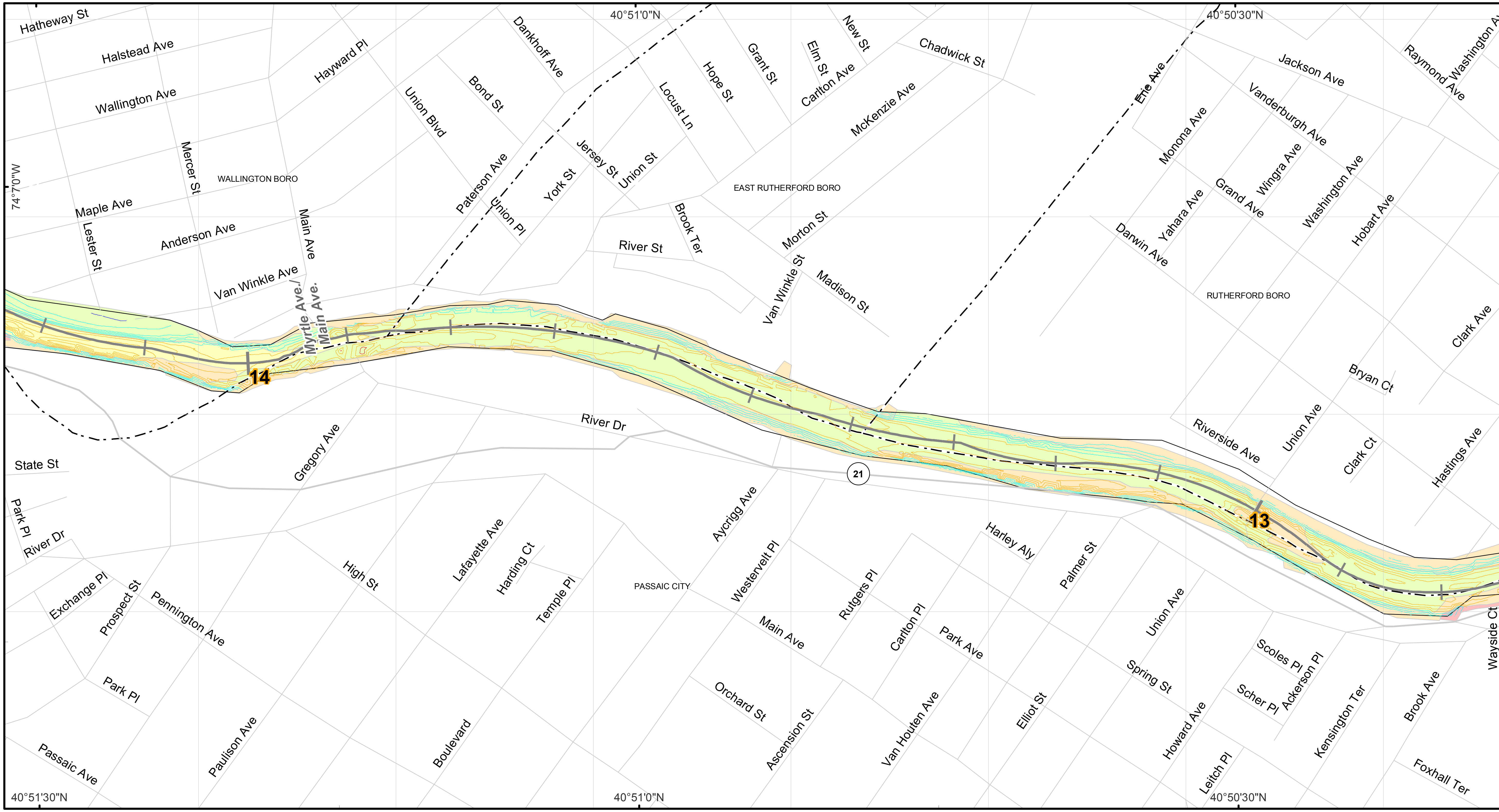

Lower Passaic River Restoration Project New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

- Rock and Coarse gravel
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2004 USACE Bathymetric Survey

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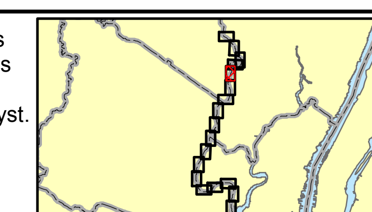

Mile 13 to 14

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10/31/2005 -- 4:45:20 PM

US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project
New Jersey

Sediment Texture Map

Legend

- Rock and Coarse gravel
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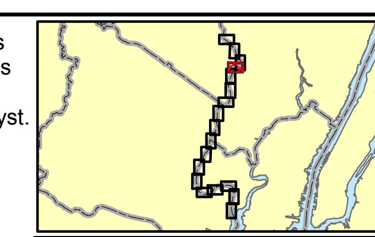
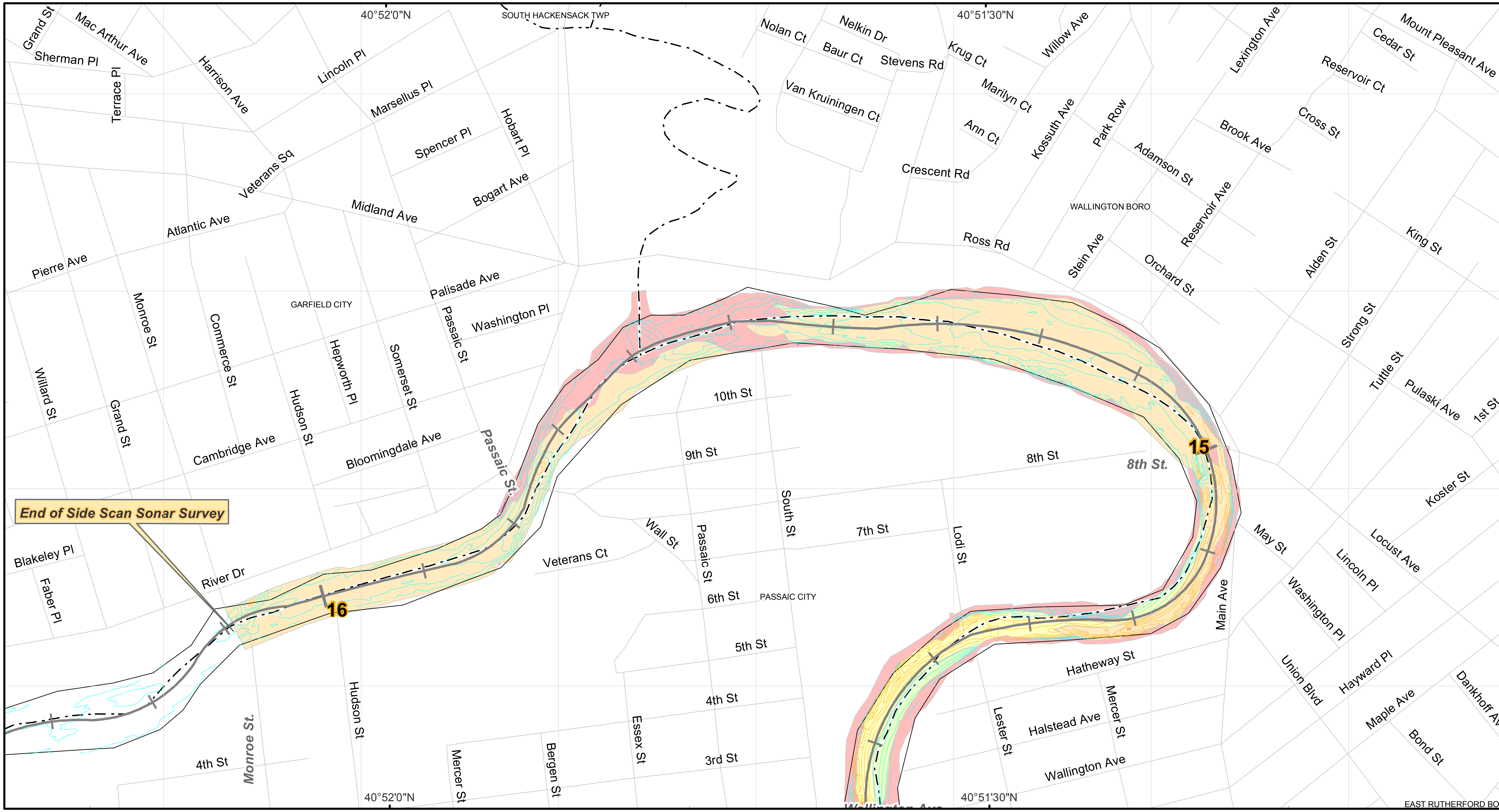
Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 14 to 15



Lower Passaic River Restoration Project
New Jersey

US Army Corps of Engineers

MALCOLM PIRNIE

Sediment Texture Map

Legend

- Rock and Coarse gravel
- Gravel and Sand
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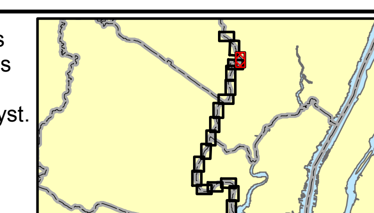
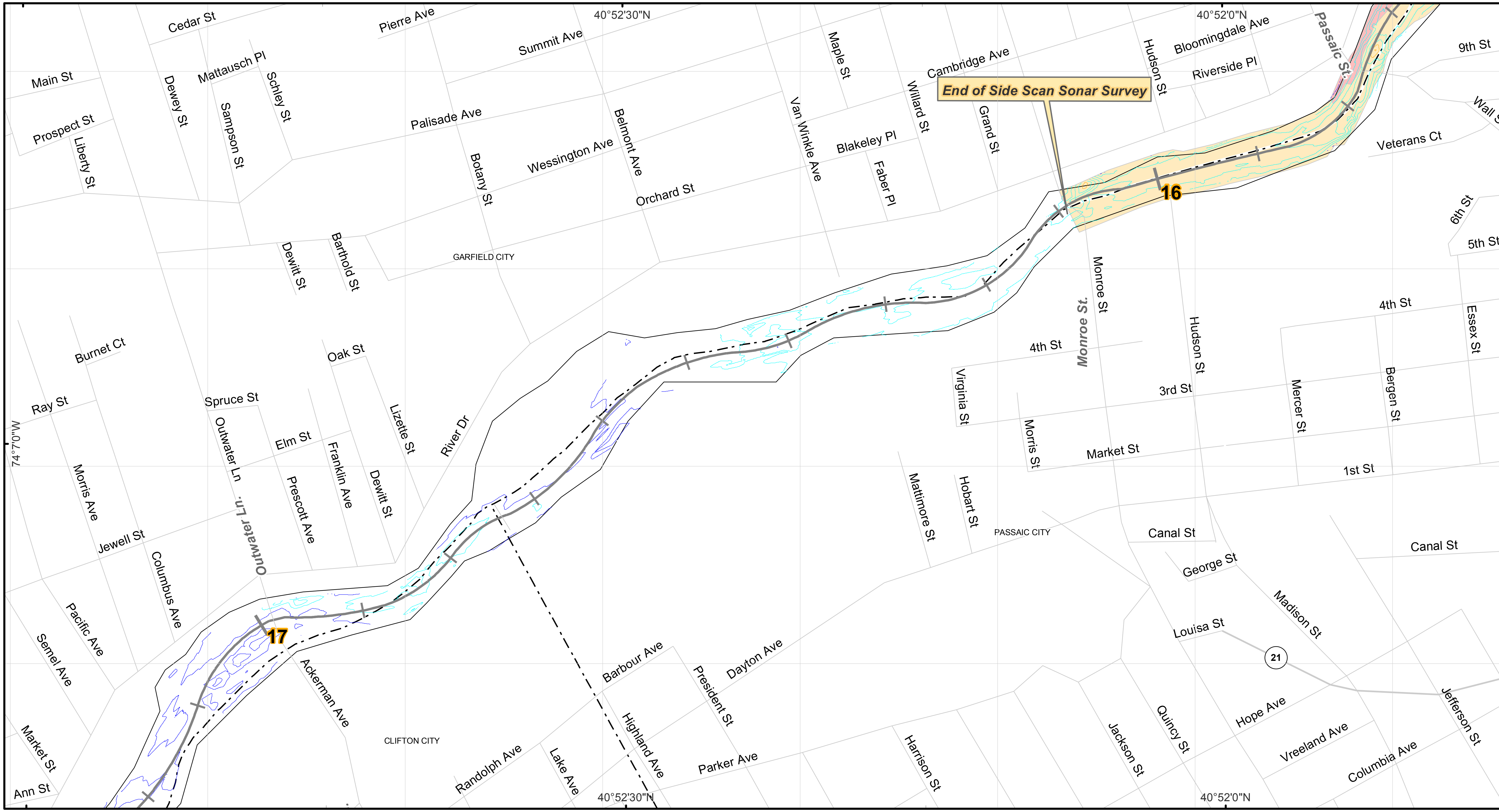


Mile 15 to 16

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sediment_Texture_Geophysical_Memo_October_2005.mxd)
10/31/2005 -- 4:45:20 PM



Lower Passaic River Restoration Project New Jersey

Sediment Texture Map

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Rock and Coarse gravel	2004 USACE Bathymetric Survey	
Gravel and Sand		
Sand	Elevation (Feet) Relative to NGVD29	
Silt and Sand	-30 to -20	-8 to 0
Silt	-18 to -10	2 to 10
River Mile Post		

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

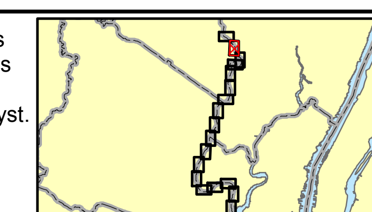
0 250 500 1,000

1 " equals 500 '

A Triangulated Irregular Network (TIN) was derived from the survey points using ESRI's 3-D Analyst in ArcGIS. Contours were interpolated from the TIN, also in 3-D Analyst.

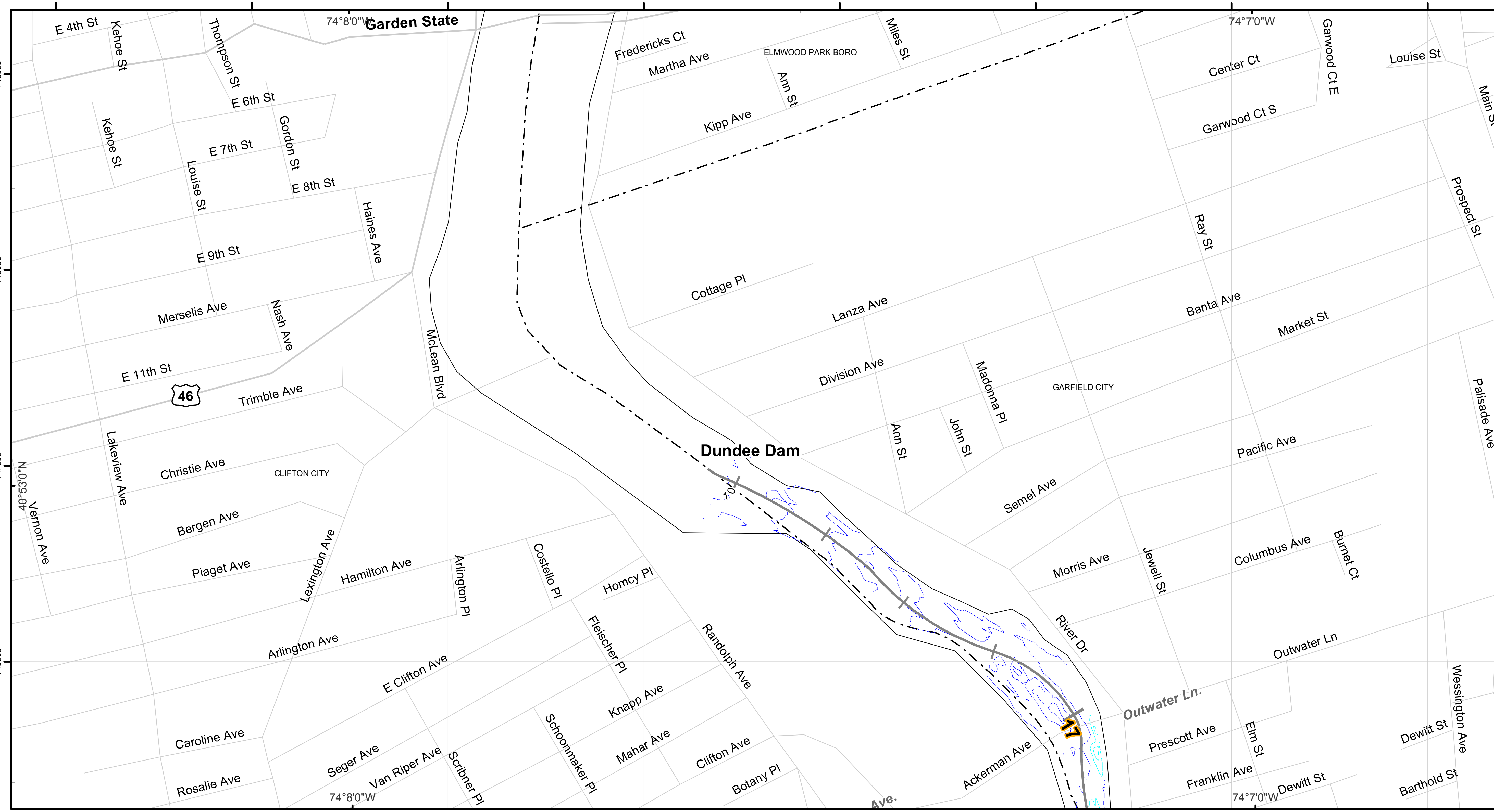
Bathymetric Control Data:
Benchmark: X 71 (NGS PID: KV0256)
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)



Mile 16 to 17

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sediment_Texture_Geophysical_Memo_October_2005.mxd)
10/31/2005 -- 4:45:20 PM



Lower Passaic River Restoration Project
New Jersey

US Army Corps of Engineers

MALCOLM PIRNIE

Sediment Texture Map

Legend

- Rock and Coarse gravel
- Gravel and Sand
- Sand
- Silt and Sand
- Silt
- River Mile Post

2004 USACE Bathymetric Survey

Elevation (Feet) Relative to NGVD29

- -30 to -20
- -18 to -10
- -8 to 0
- 2 to 10

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

N

0 250 500 1,000

1 " equals 500 '

A Triangulated Irregular Network (TIN) was derived from the survey points using ESRI's 3-D Analyst in ArcGIS. Contours were interpolated from the TIN, also in 3-D Analyst.

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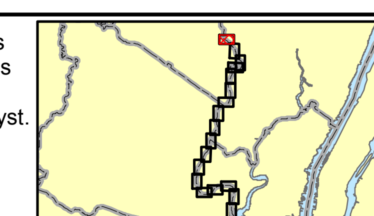
Elevation: 15.12 FEET (NGVD 29)

Benchmark: V 71 (NGS PID: KV0254)
Elevation: 15.76 FEET (NGVD 29)

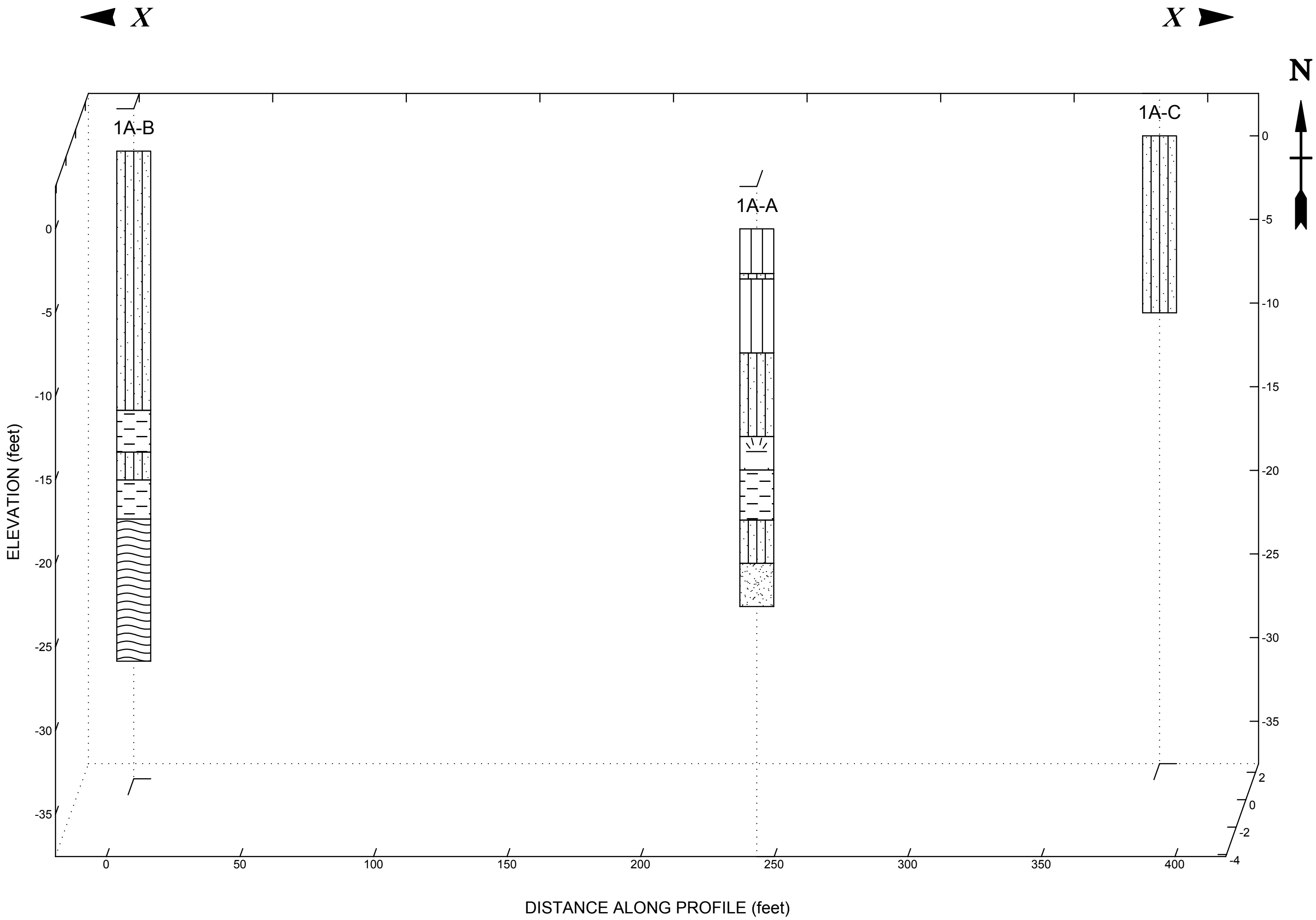


Mile 17 to Dundee Dam

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Sediment_Texture_Geophysical_Memo_October_2005.mxd)
10/31/2005 -- 4:45:20 PM

Attachment 3: Fence Diagrams

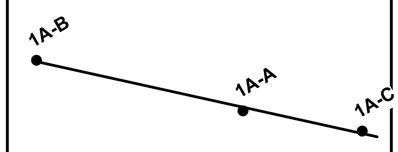
Fence diagrams displaying sub-bottom geological units from geotechnical borings collected during the June 2005 geophysical survey and classified by Malcolm Pirnie, Inc. using the United Soil Classification System (USCS) [refer to the Draft Technical Report: Geophysical Survey (Aqua Survey, Inc., 2005) for more information]. Note that the fence diagrams extend to RM 16.



Lithology Graphics

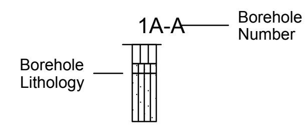
Silt | Sandy Silt | Silty Sand or Silt and Sand | Peat

Low plasticity clay | Fine to Medium Sand | High plasticity clay



Site Map Scale 1 inch equals 220 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.

0 63

Horizontal Scale (feet)

Vertical Exaggeration: 6.5x

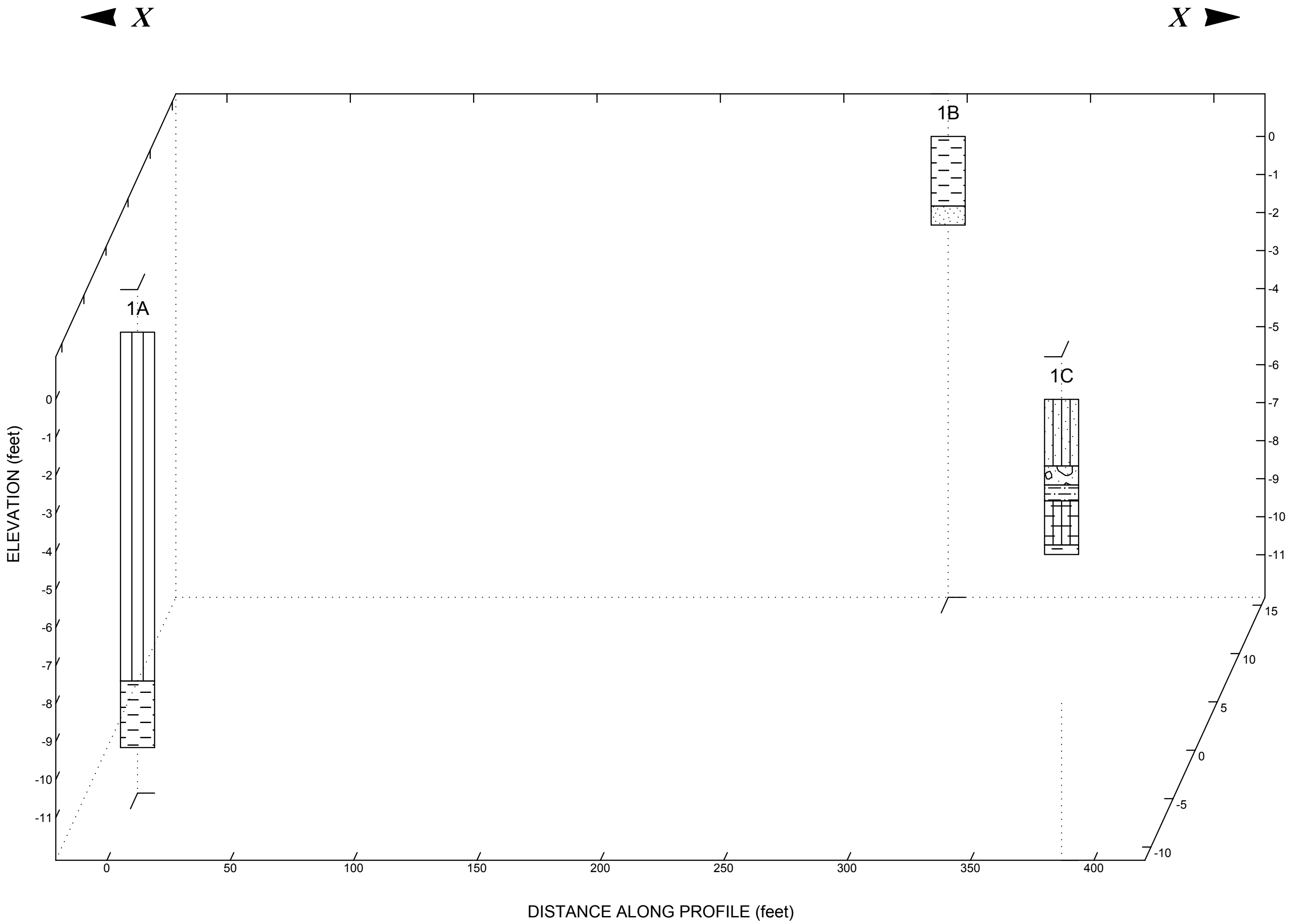
Malcolm Pirnie, Inc.

Location : Mile 0

MALCOLM PIRNIE

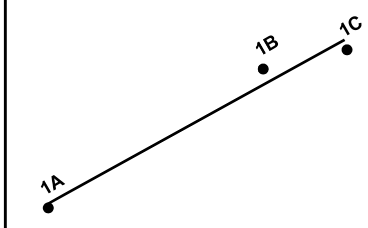
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	1A-A - 1A-C



Lithology Graphics

Silt
Low plasticity clay
Fine Sand
Silty Sand or Silt and Sand
Gravelly Sand
Sandy Clay.
Silty Clay



Site Map Scale 1 inch equals 220 feet

Explanation

1A — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

0 69

Horizontal Scale (feet)

Vertical Exaggeration: 15.5x

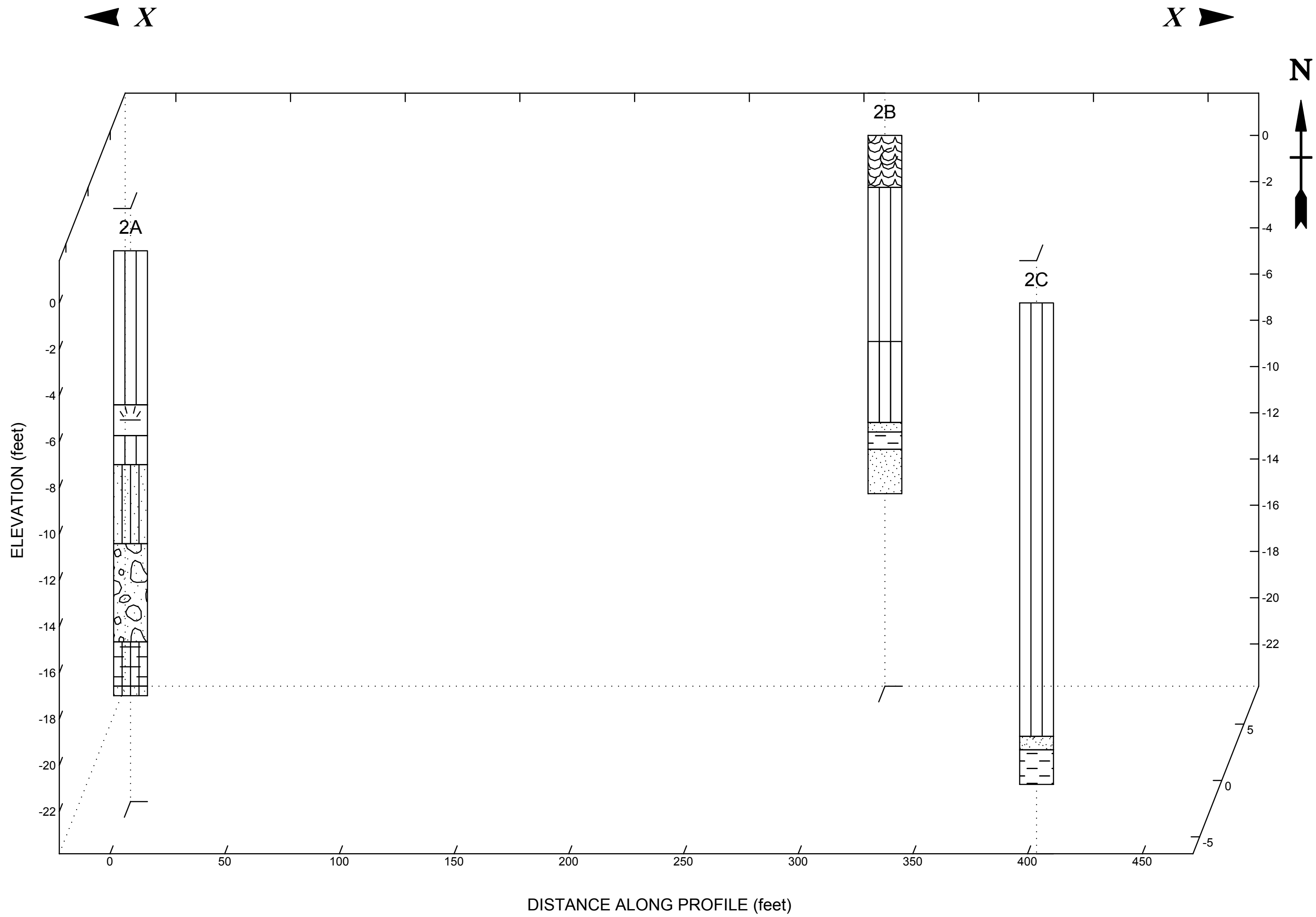
Malcolm Pirnie, Inc.

Location : Mile 1

MALCOLM PIRNIE

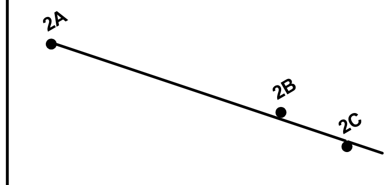
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	1A - 1C



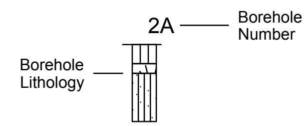
Lithology Graphics

- Silt
- Peat
- Silty Sand or Silt and Sand
- Gravelly Sand
- Silty Clay
- Organic silt or clay with shells
- Fine Sand
- Low plasticity clay
- Fine to Medium Sand



Site Map Scale 1 inch equals 250 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.

Horizontal Scale (feet)

Vertical Exaggeration: 10x

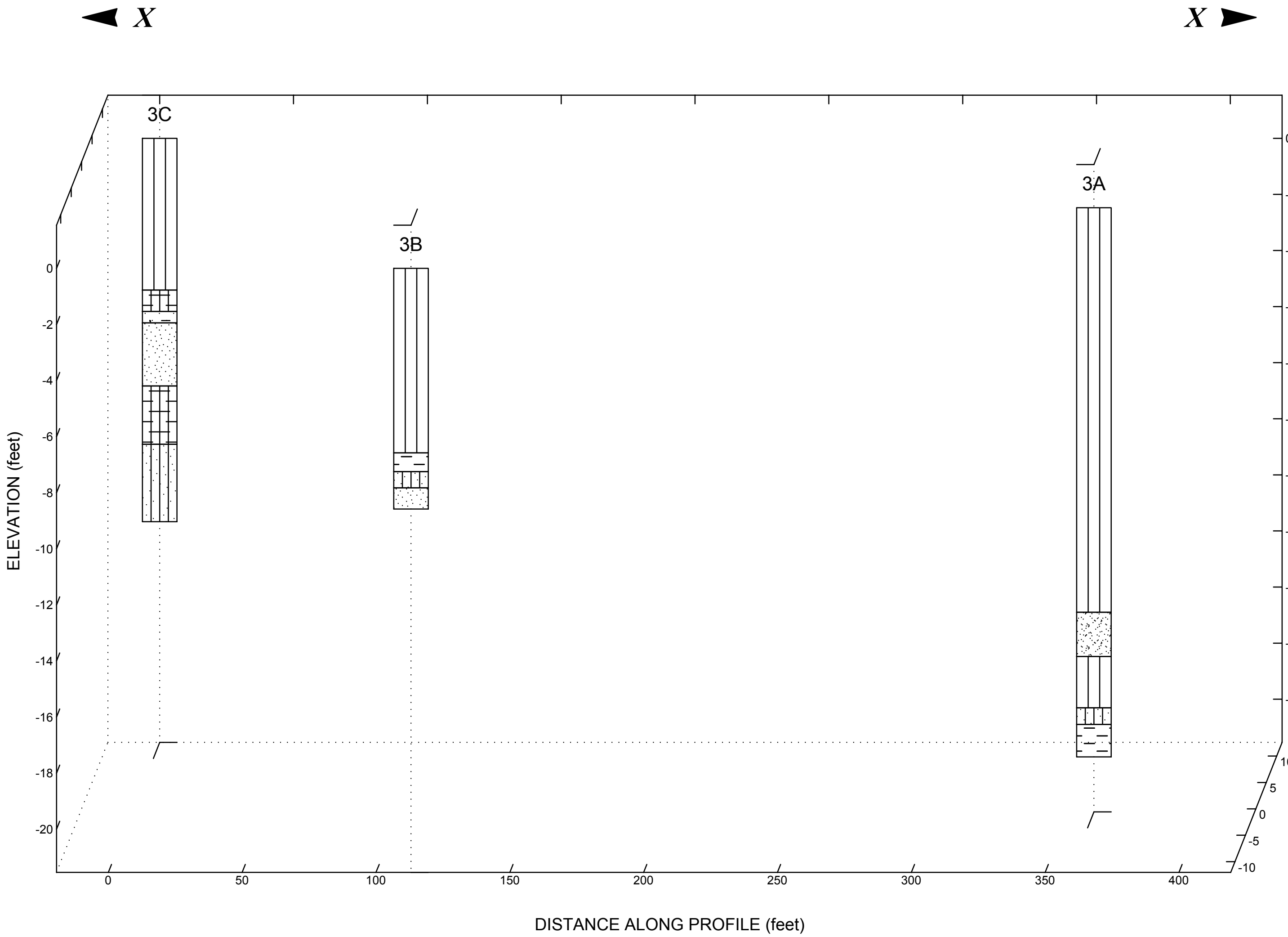
Malcolm Pirnie, Inc.

Location : Mile 2

MALCOLM PIRNIE

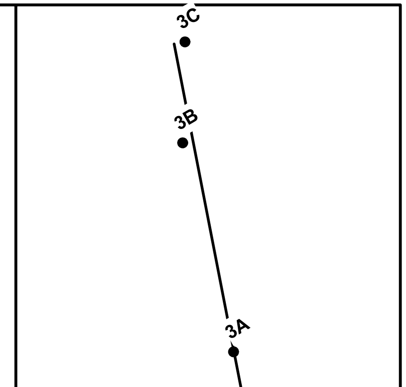
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	2A - 2C



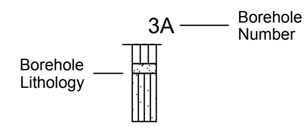
Lithology Graphics

- Silt
- Fine Sand
- Medium Sand
- Silty Clay
- Silty Sand or Silt and Sand
- Clayey Sand or Sand and Clay
- Low plasticity clay



Site Map Scale 1 inch equals 220 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.

Horizontal Scale (feet)

Vertical Exaggeration: 10.5x

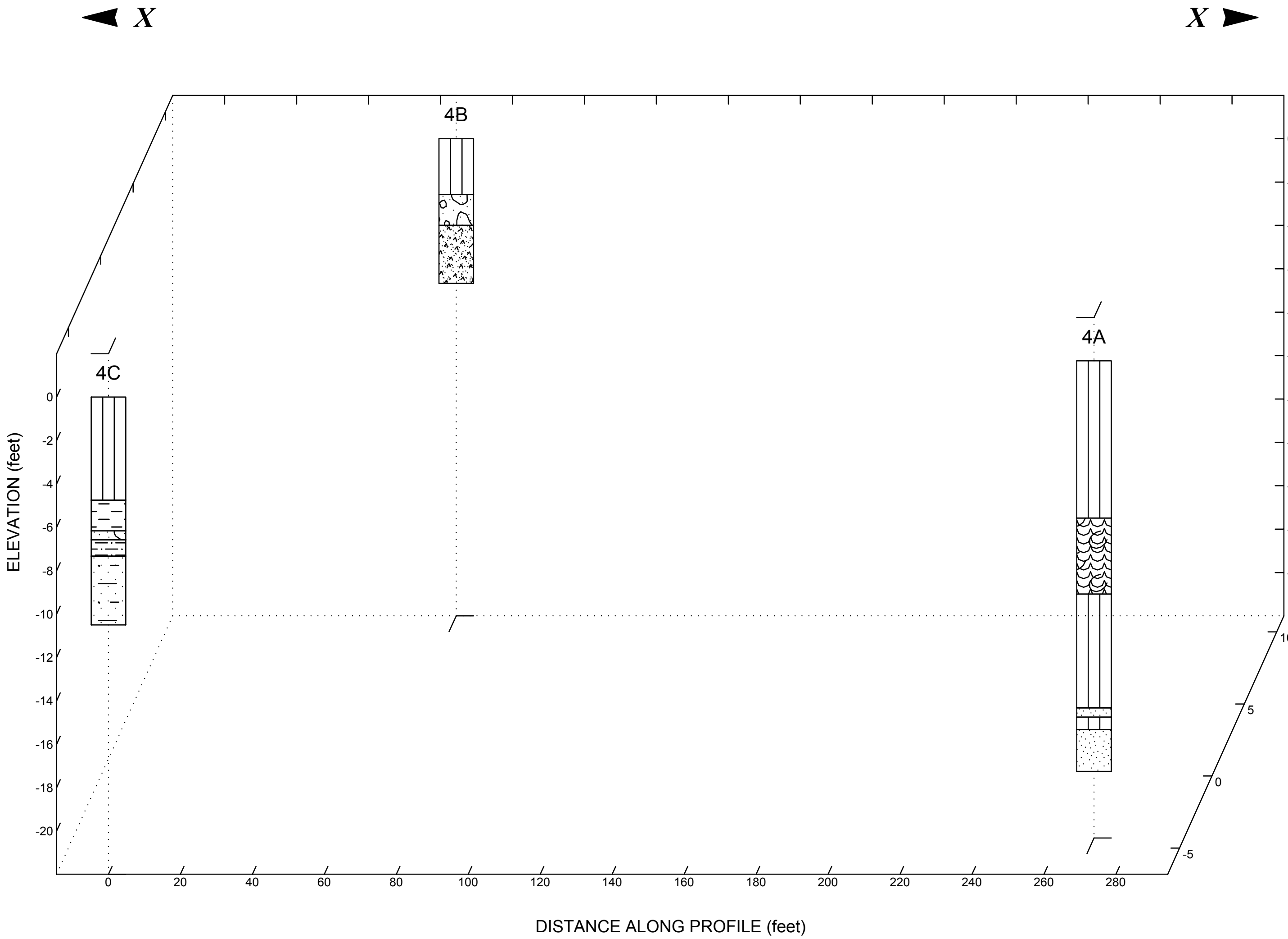
Malcolm Pirnie, Inc.

Location: Mile 3

MALCOLM PIRNIE

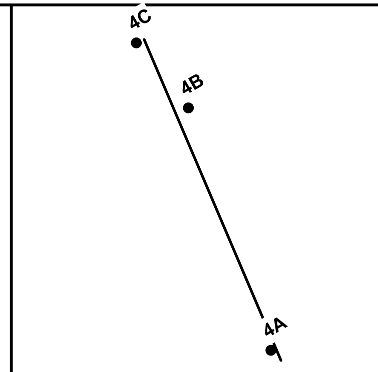
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	3A-3C



Lithology Graphics

- Silt
- Organic silt or clay with shells
- Fine Sand
- Gravelly Sand
- Medium - Coarse Sand
- Low plasticity clay
- Sandy Gravel
- Sandy Clay.
- Clayey Sand or Sand and Clay



Site Map Scale 1 inch equals 155 feet

Explanation

4A — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

0 48

Horizontal Scale (feet)

Vertical Exaggeration: 6x

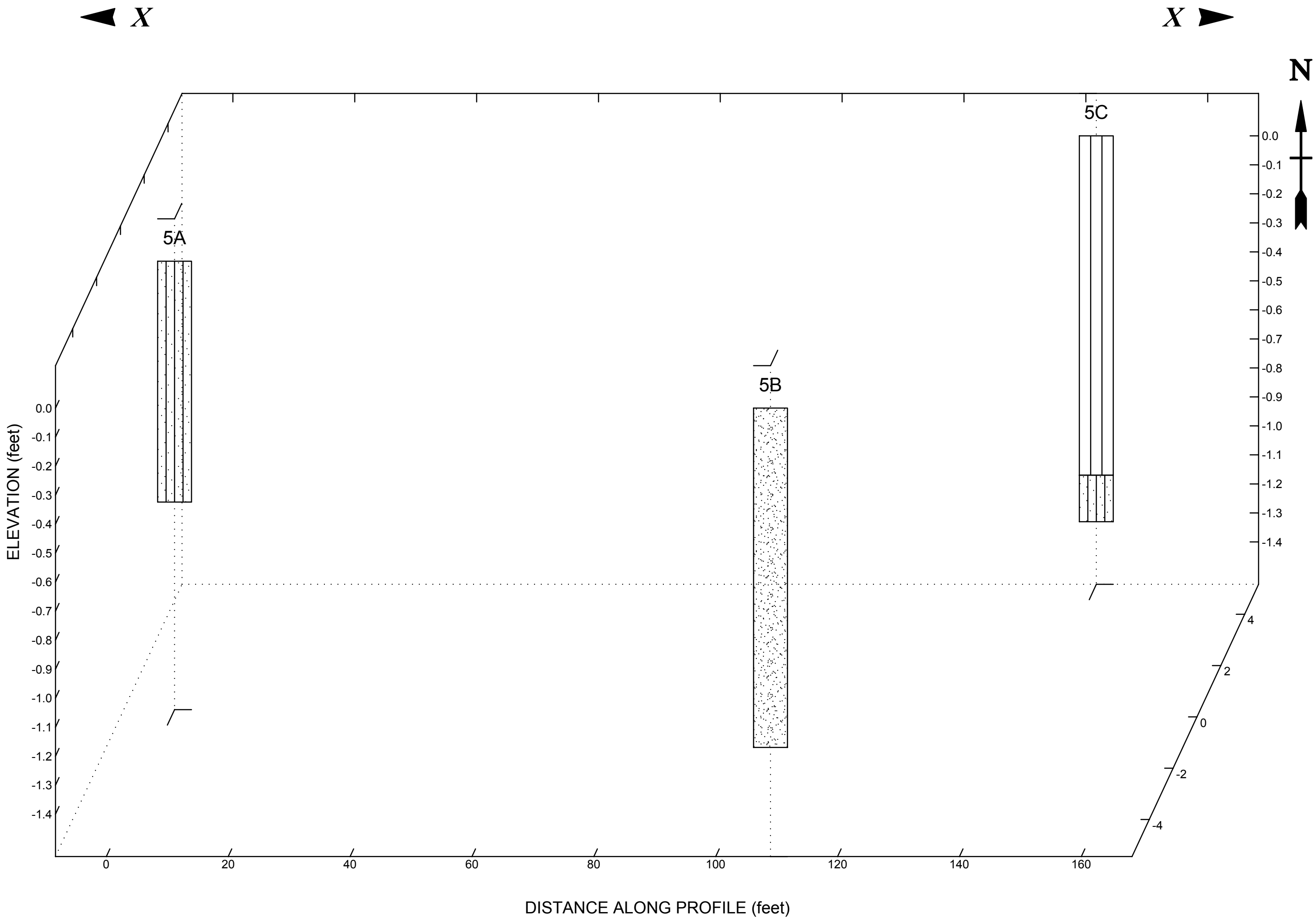
Malcolm Pirnie, Inc.

Location : Mile 4

MALCOLM PIRNIE

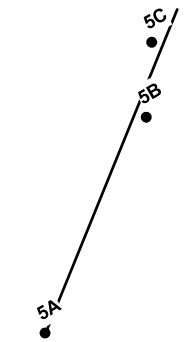
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	4A - 4C



Lithology Graphics

Sandy Silt | Fine to Medium Sand | Silt | Silty Sand or Silt and Sand



Site Map Scale 1 inch equals 90 feet

Explanation

5A — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

0 28

Horizontal Scale (feet)

Vertical Exaggeration: 47.5x

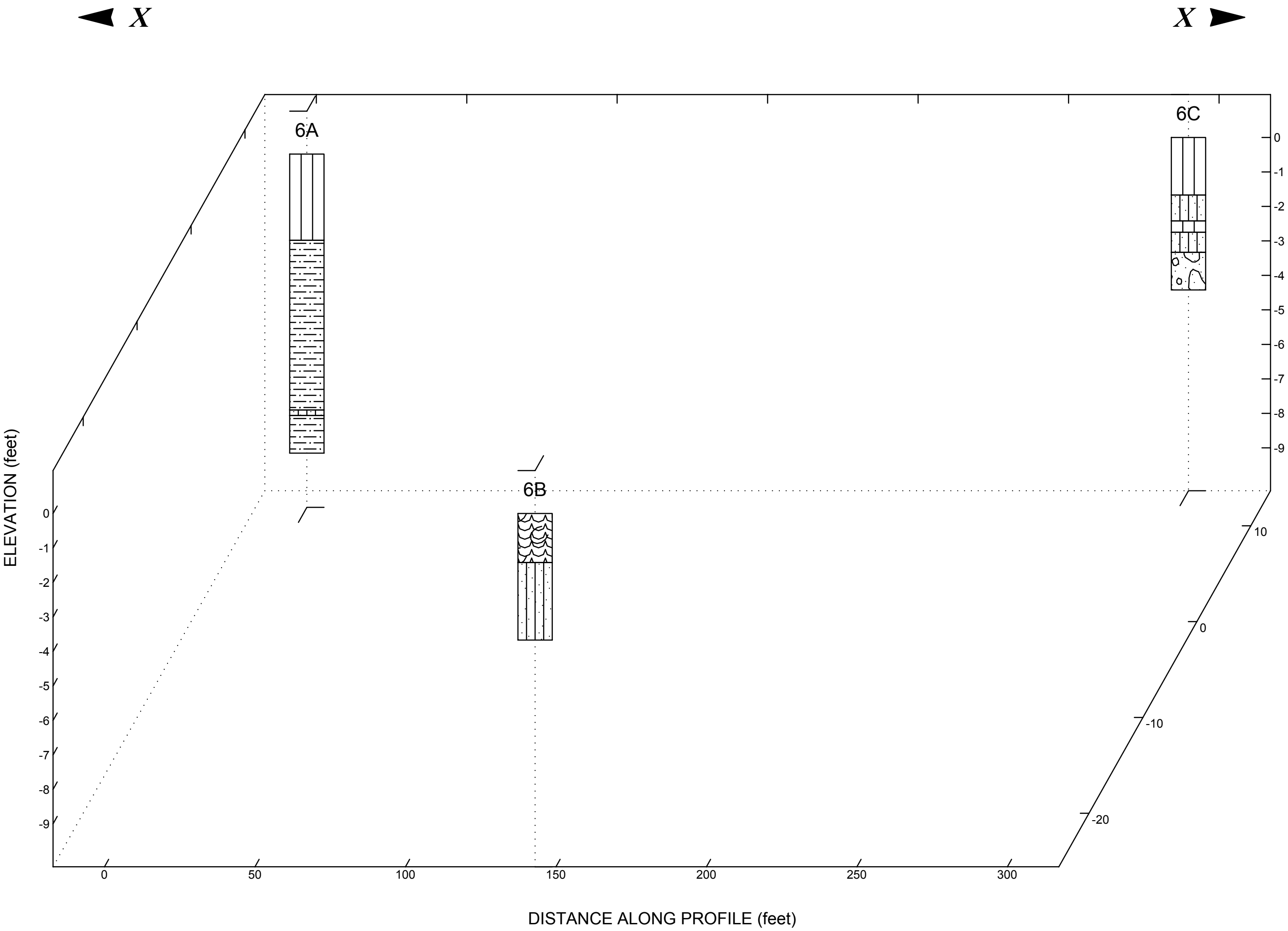
Malcolm Pirnie, Inc.

Location : Mile 5

MALCOLM PIRNIE

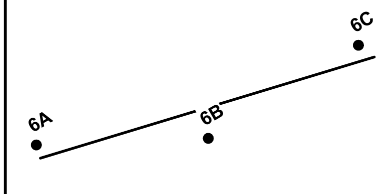
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	5A - 5C



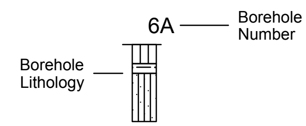
Lithology Graphics

- Silt
- Sandy Clay.
- Sandy Silt
- Organic silt or clay with shells
- Gravelly Sand



Site Map Scale 1 inch equals 165 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.

Horizontal Scale (feet)

Vertical Exaggeration: 11.5x

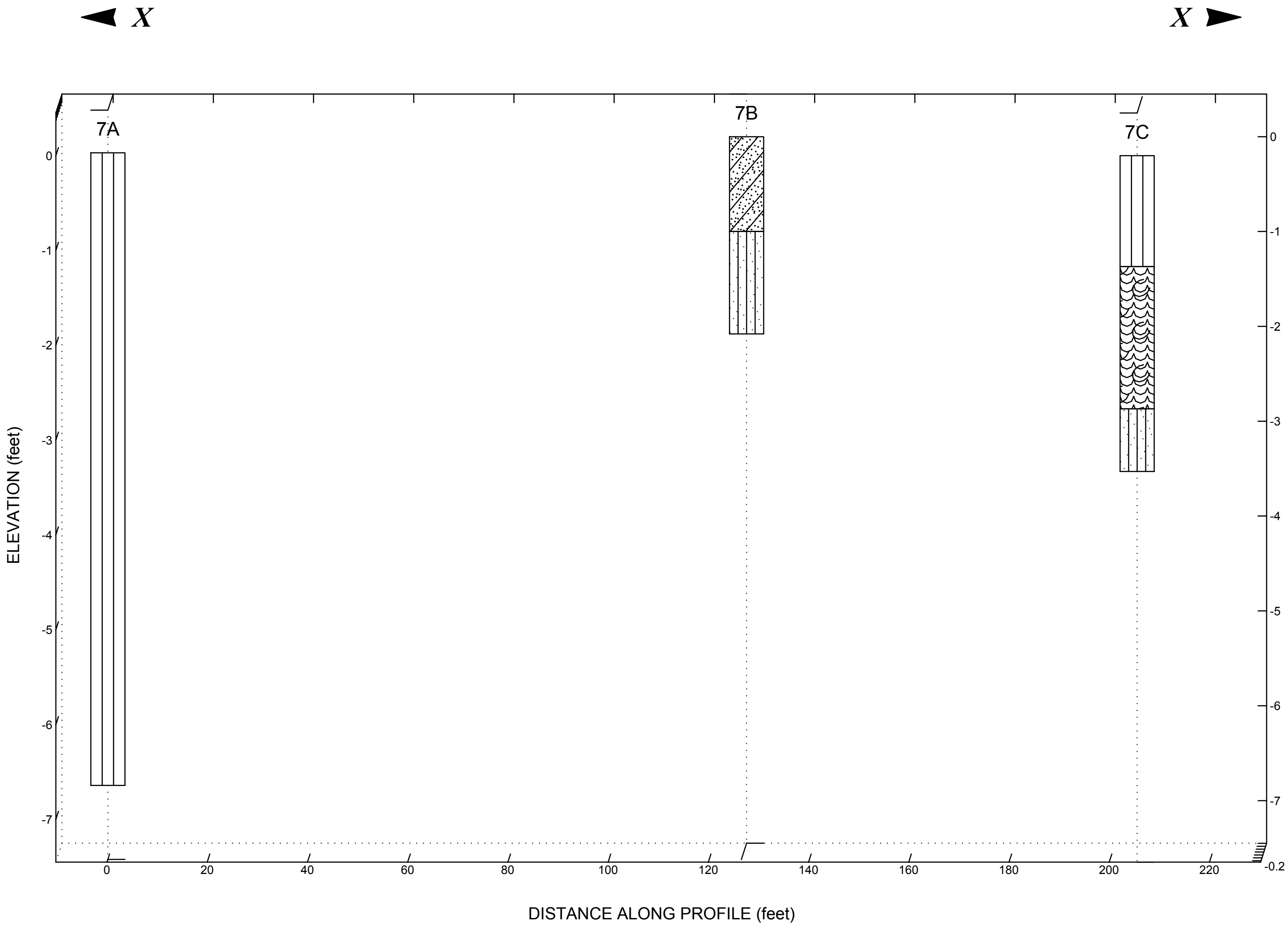
Malcolm Pirnie, Inc.

Location : Mile 6

MALCOLM PIRNIE

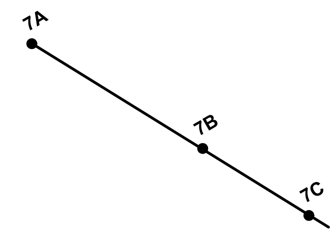
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	6A - 6C



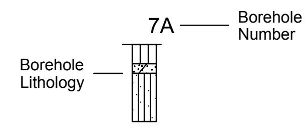
Lithology Graphics

Silt | Silty sand/Silt mix | Silty Sand or Silt and Sand | Organic silt or clay with shells



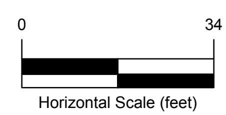
Site Map Scale 1 inch equals 120 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.



Vertical Exaggeration: 19x

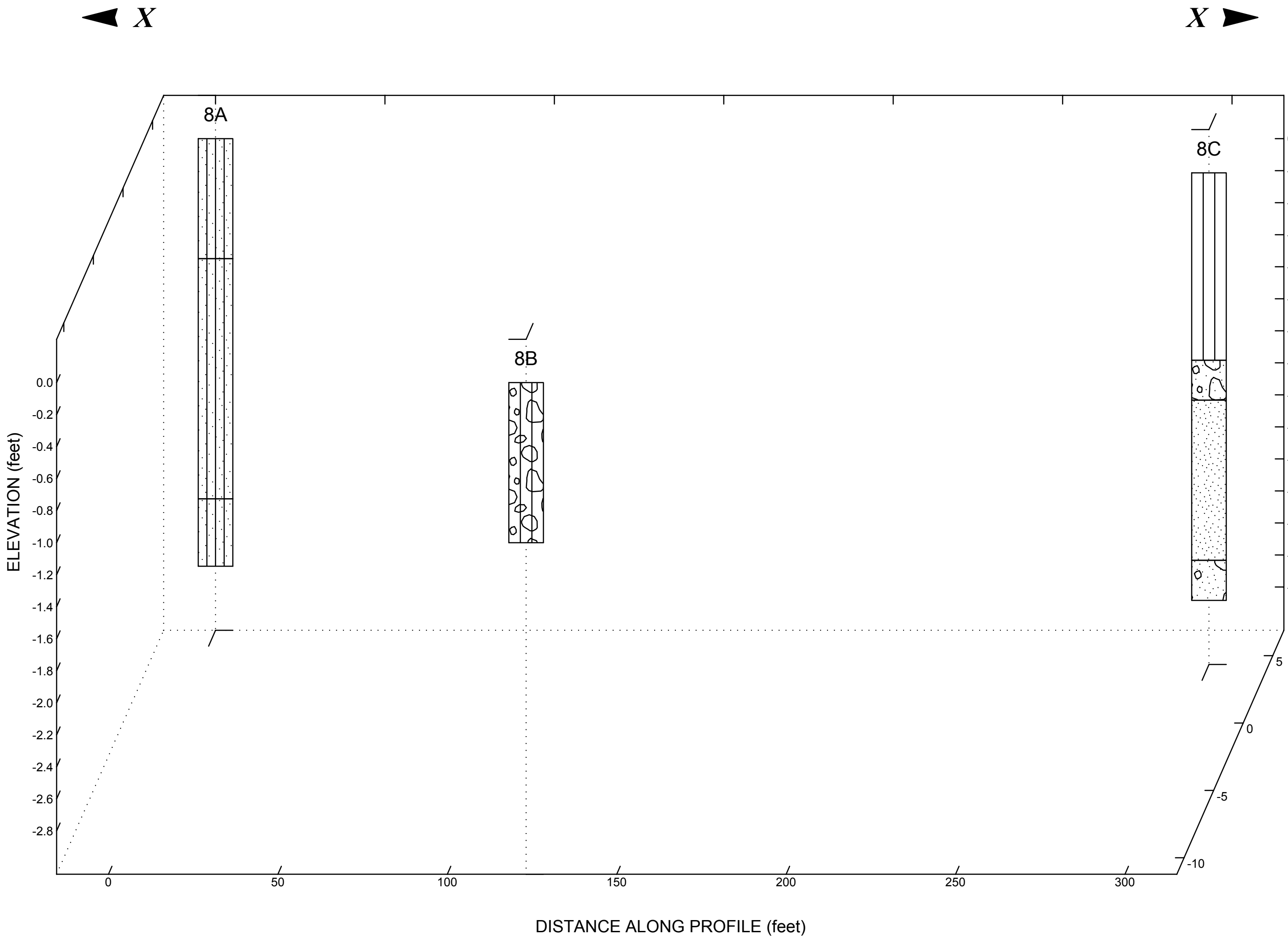
Malcolm Pirnie, Inc.

Location : Mile 7

MALCOLM PIRNIE

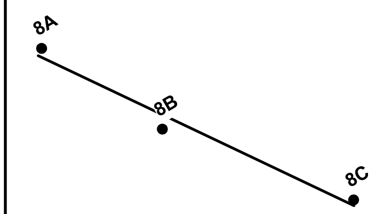
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	7A - 7C



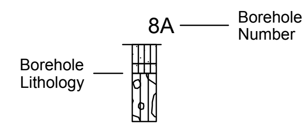
Lithology Graphics

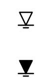
- Silty Sand or Silt and Sand
- Sandy Silt
- Silty Gravel
- Silt
- Gravelly Sand
- Fine Sand
- Sandy Gravel



Site Map Scale 1 inch equals 165 feet

Explanation





Water Level Reading at time of drilling.

Water Level Reading after drilling.

Horizontal Scale (feet)

Vertical Exaggeration: 47x

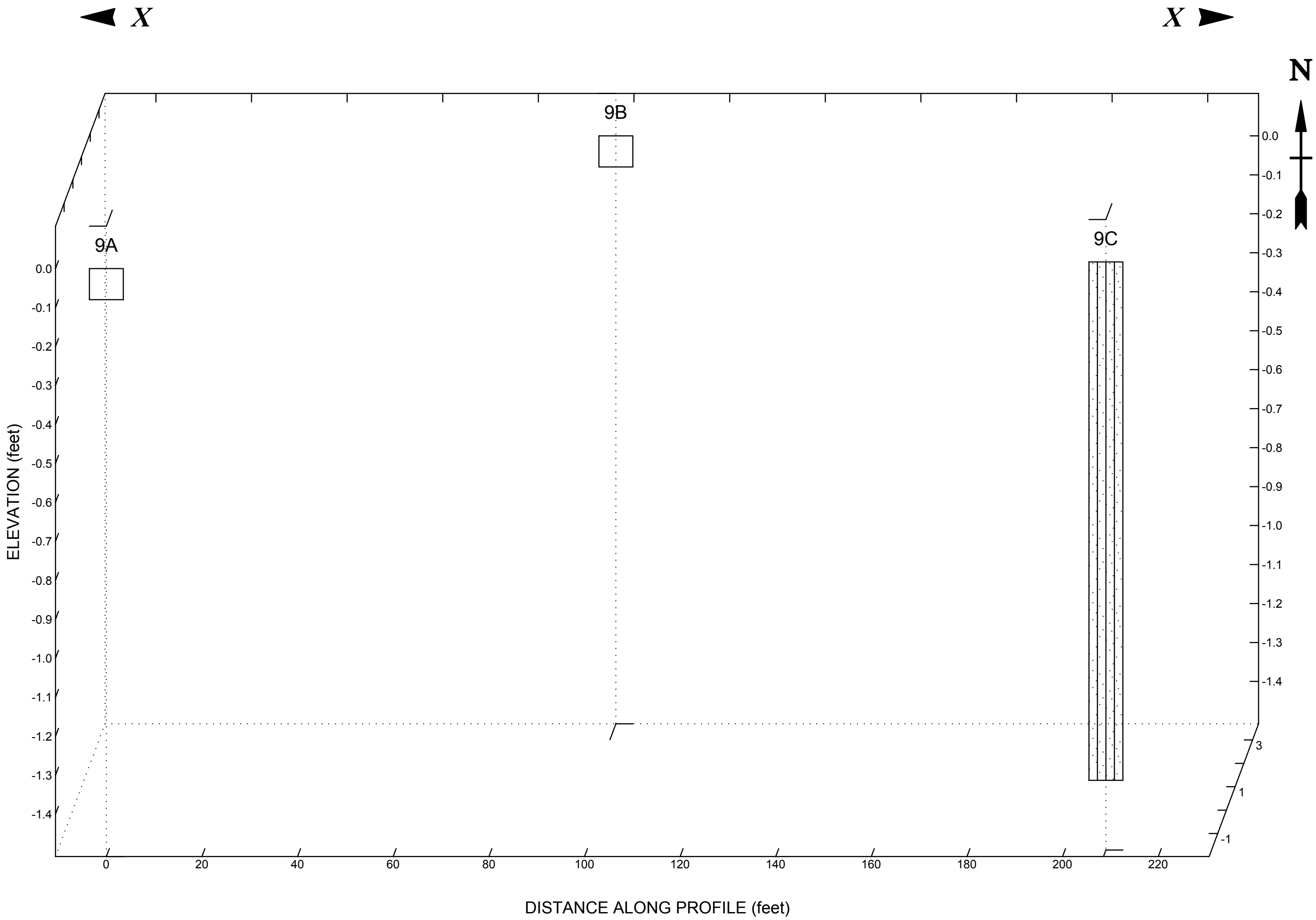
Malcolm Pirnie, Inc.

Location : Mile 8

MALCOLM PIRNIE

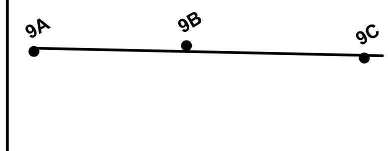
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	8A - 8C



Lithology Graphics

Silty Sand or Silt and Sand



Site Map Scale 1 inch equals 120 feet

Explanation

9A — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

0 35

Horizontal Scale (feet)

Vertical Exaggeration: 81.5x

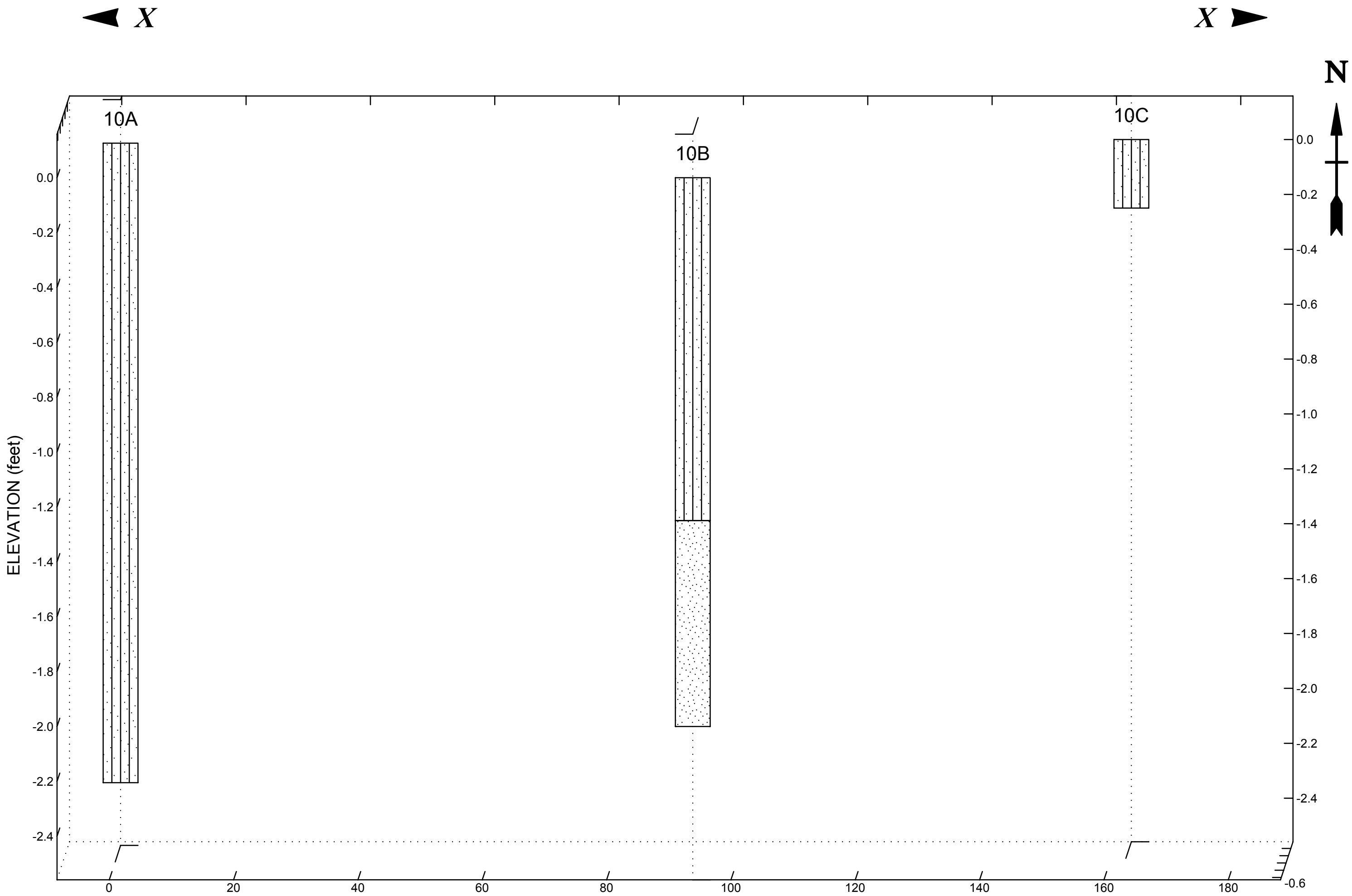
Malcolm Pirnie, Inc.

Location : Mile 9

MALCOLM PIRNIE

Lower Passaic River
New Jersey

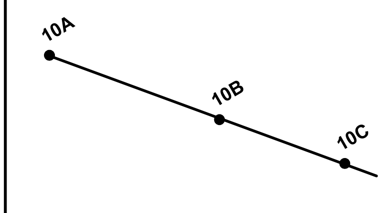
JOB NUMBER	TRANSECT NUMBER
3473007	9A - 9C



Lithology Graphics

Silty Sand or Silt and Sand

Fine Sand



Site Map Scale 1 inch equals 100 feet

Explanation

10A — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Horizontal Scale (feet)

Vertical Exaggeration: 44x

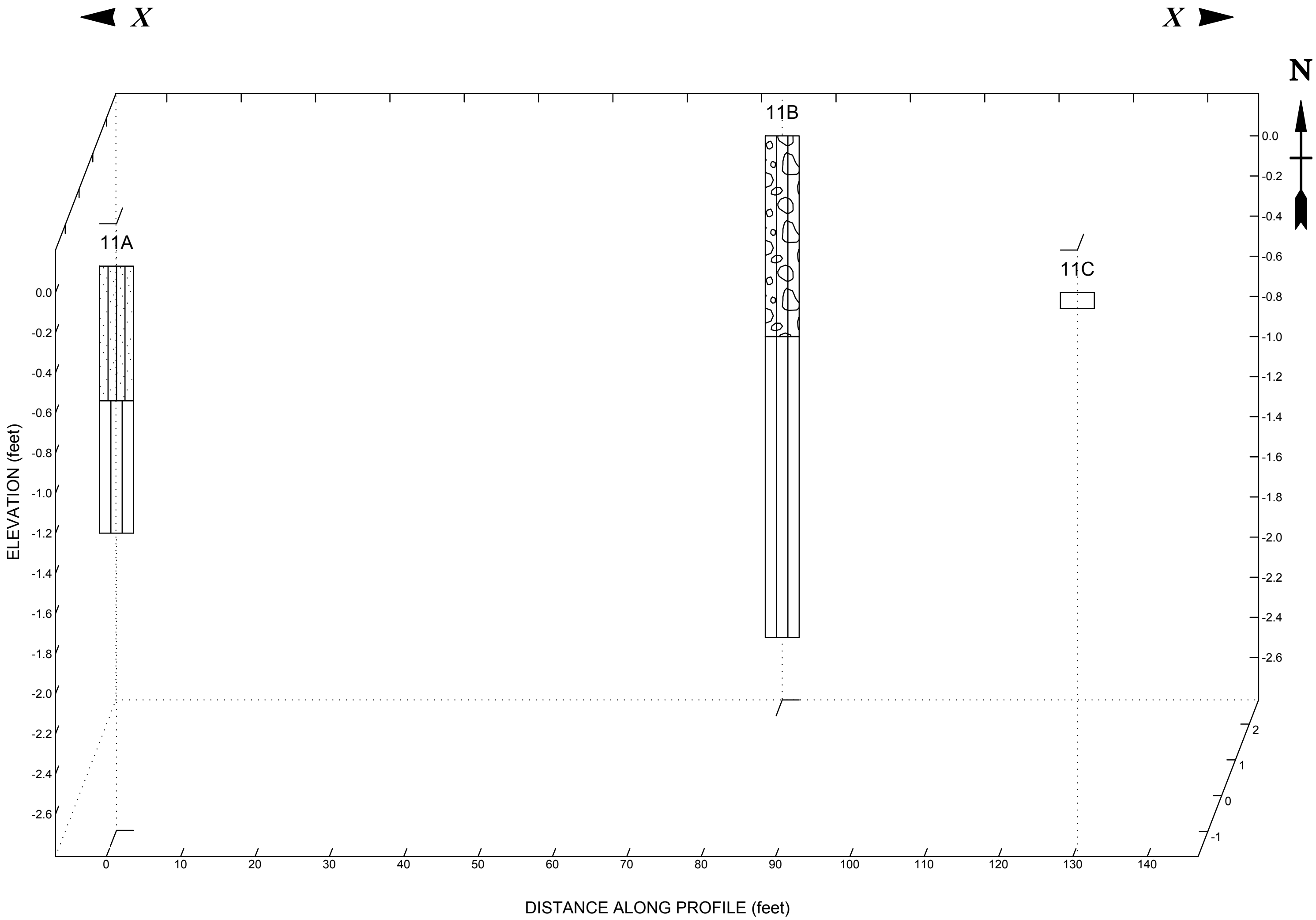
Malcolm Pirnie, Inc.

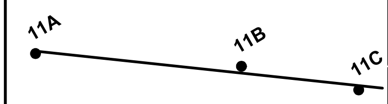
Location : Mile 10

MALCOLM PIRNIE

Lower Passaic River
New Jersey

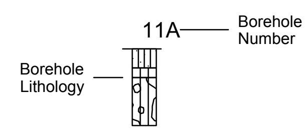
JOB NUMBER	TRANSECT NUMBER
3473007	10A - 10C





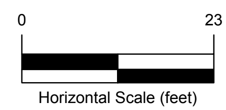
Site Map Scale 1 inch equals 75 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.



Vertical Exaggeration: 27x

Lithology Graphics

Silty Sand or Silt and Sand | Silt | Silty Gravel

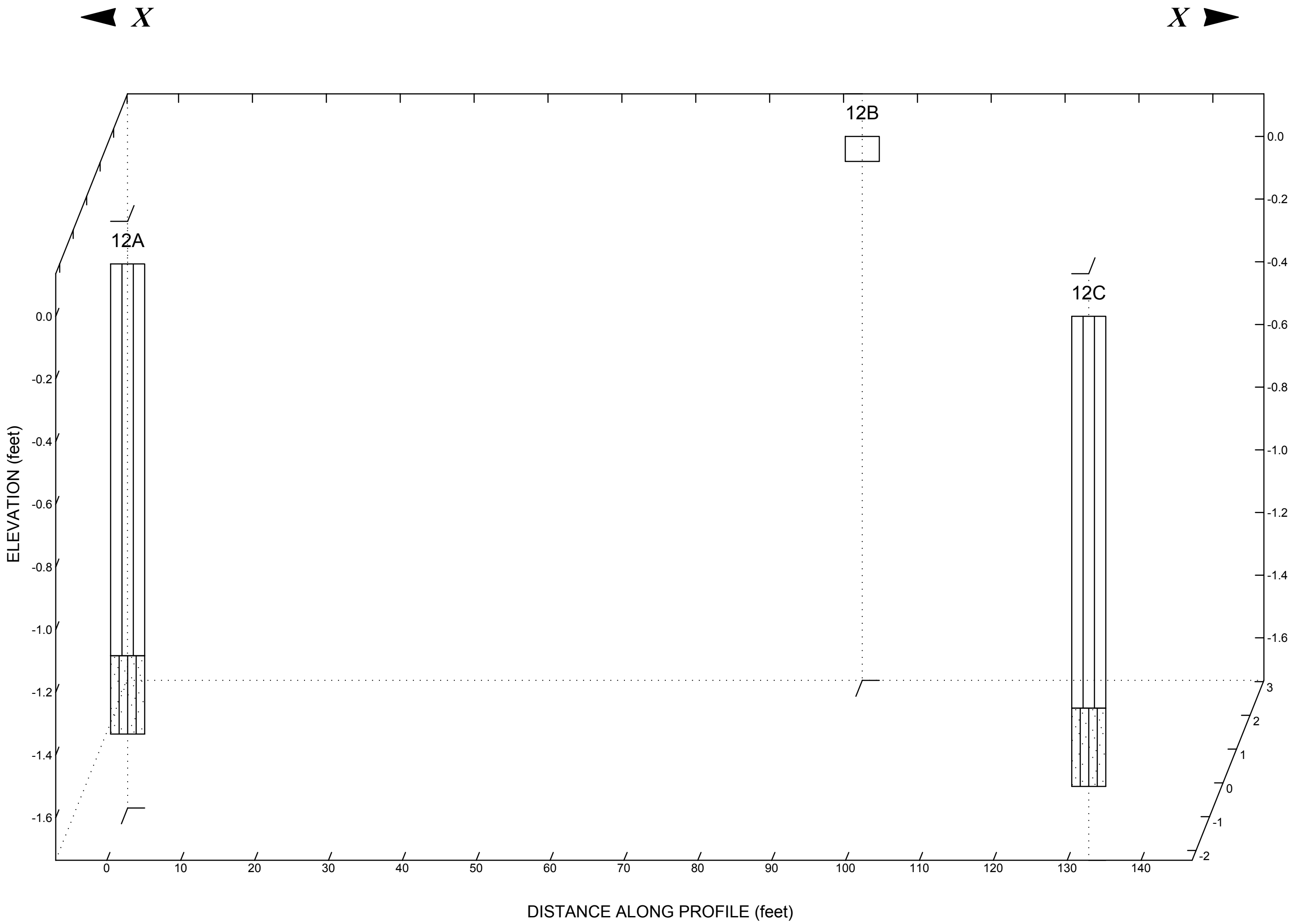
Malcolm Pirnie, Inc.

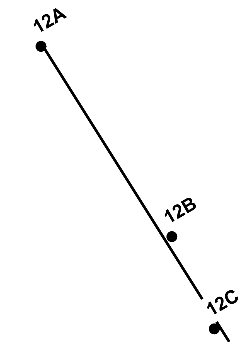
Location : Mile 11

MALCOLM PIRNIE

Lower Passaic River
New Jersey

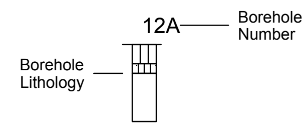
JOB NUMBER	TRANSECT NUMBER
3473007	11A - 11C





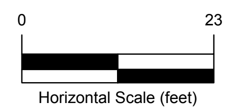
Site Map Scale 1 inch equals 75 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.



Vertical Exaggeration: 42.5x

Lithology Graphics

Silt

Silty Sand or Silt and Sand

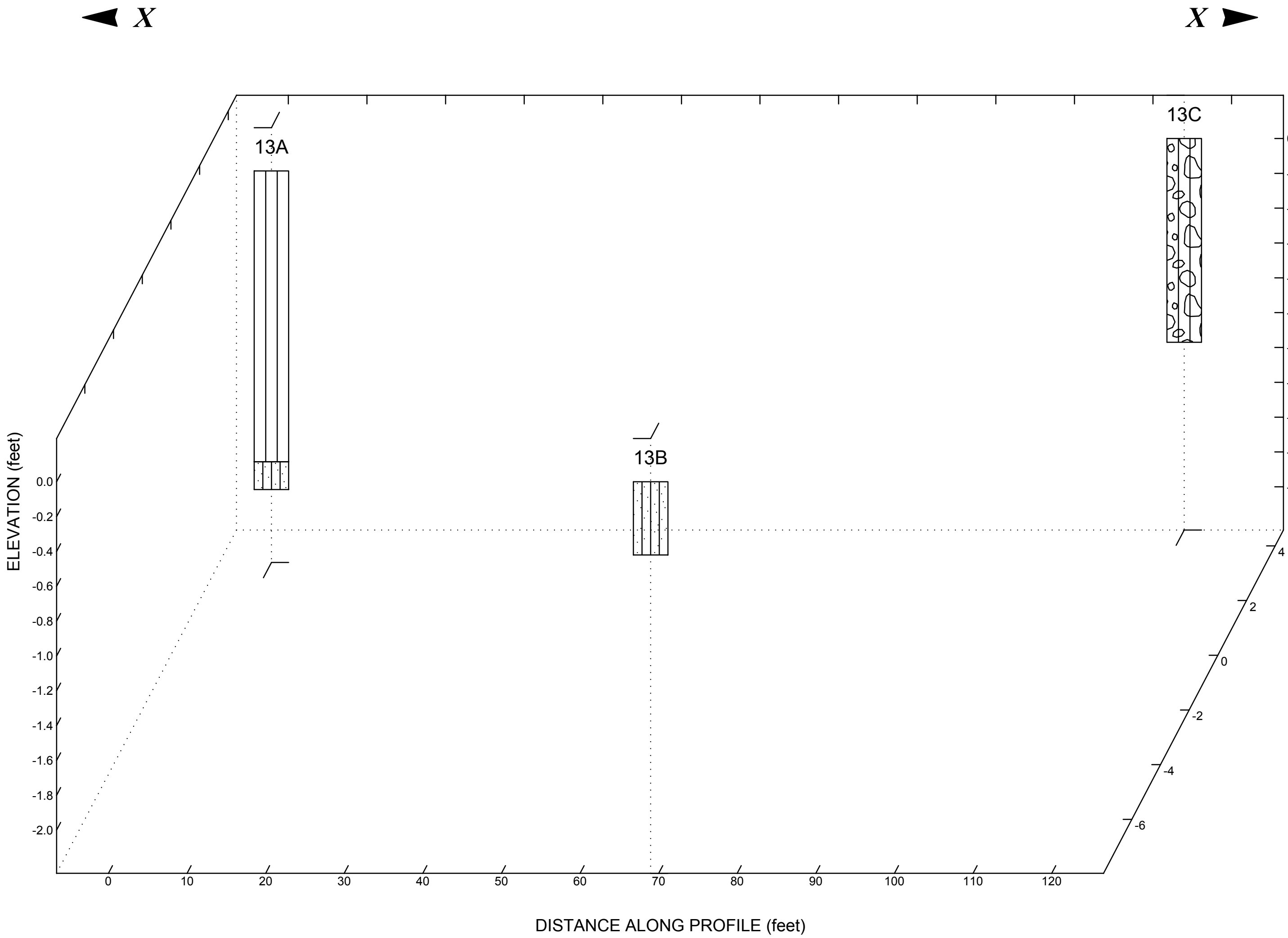
Malcolm Pirnie, Inc.

Location : Mile 12

Lower Passaic River
New Jersey

MALCOLM PIRNIE

JOB NUMBER	TRANSECT NUMBER
3473007	12A - 12C

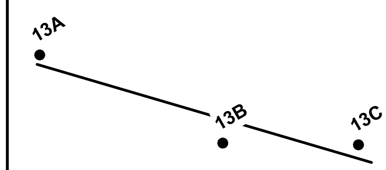


Lithology Graphics

Silt

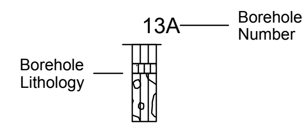
Silty Sand or Silt and Sand

Silty Gravel



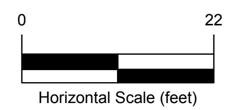
Site Map Scale 1 inch equals 65 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.



Vertical Exaggeration: 22x

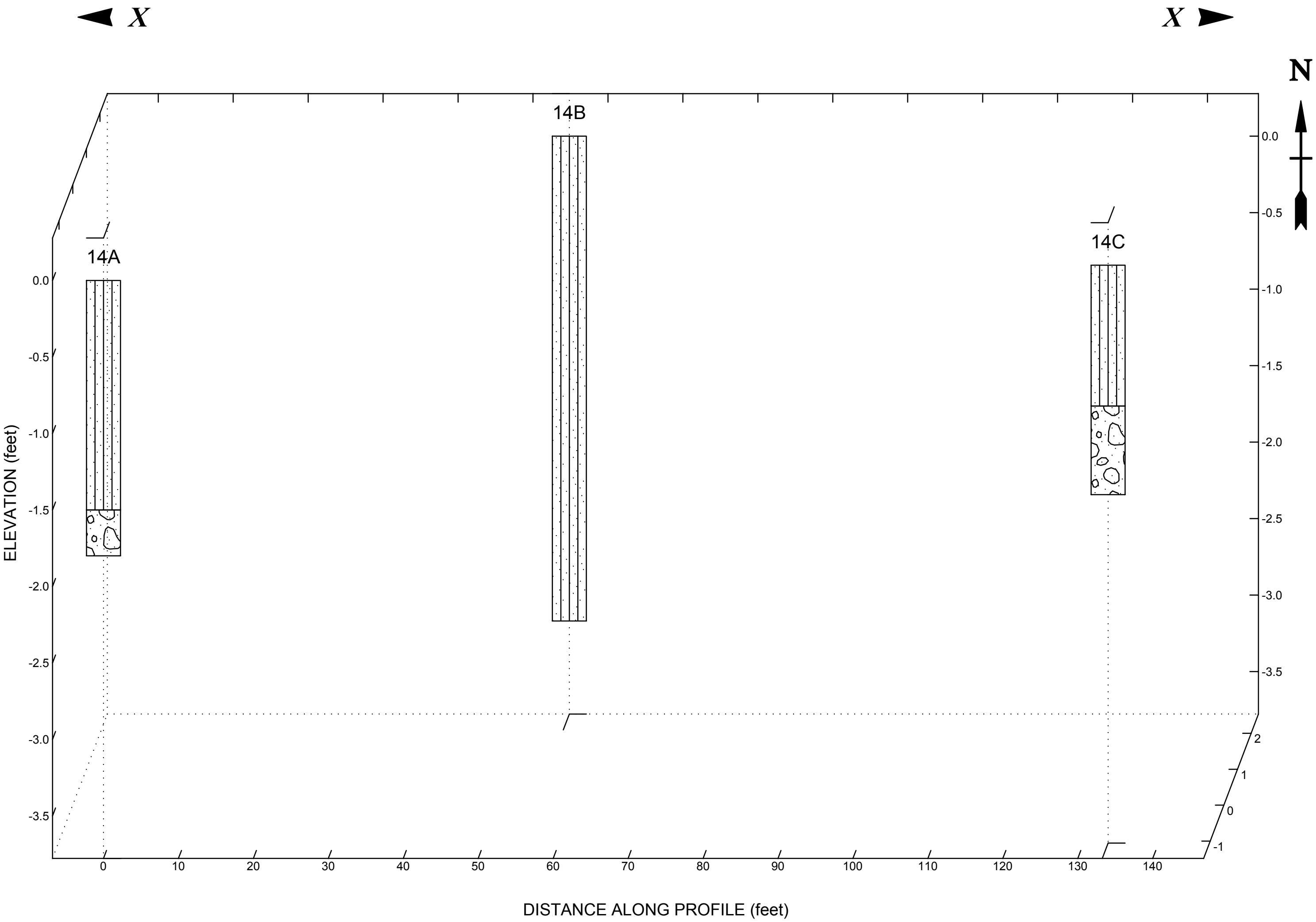
Malcolm Pirnie, Inc.

Location : Mile 13

MALCOLM PIRNIE

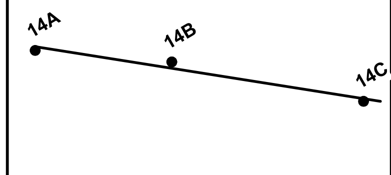
Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	13A - 13C



Lithology Graphics

Silty Sand or Silt and Sand | Gravelly Sand



Site Map Scale 1 inch equals 75 feet

Explanation

14A — Borehole Number

Borehole Lithology

Water Level Reading at time of drilling.

Water Level Reading after drilling.

0 23

Horizontal Scale (feet)

Vertical Exaggeration: 20.5x

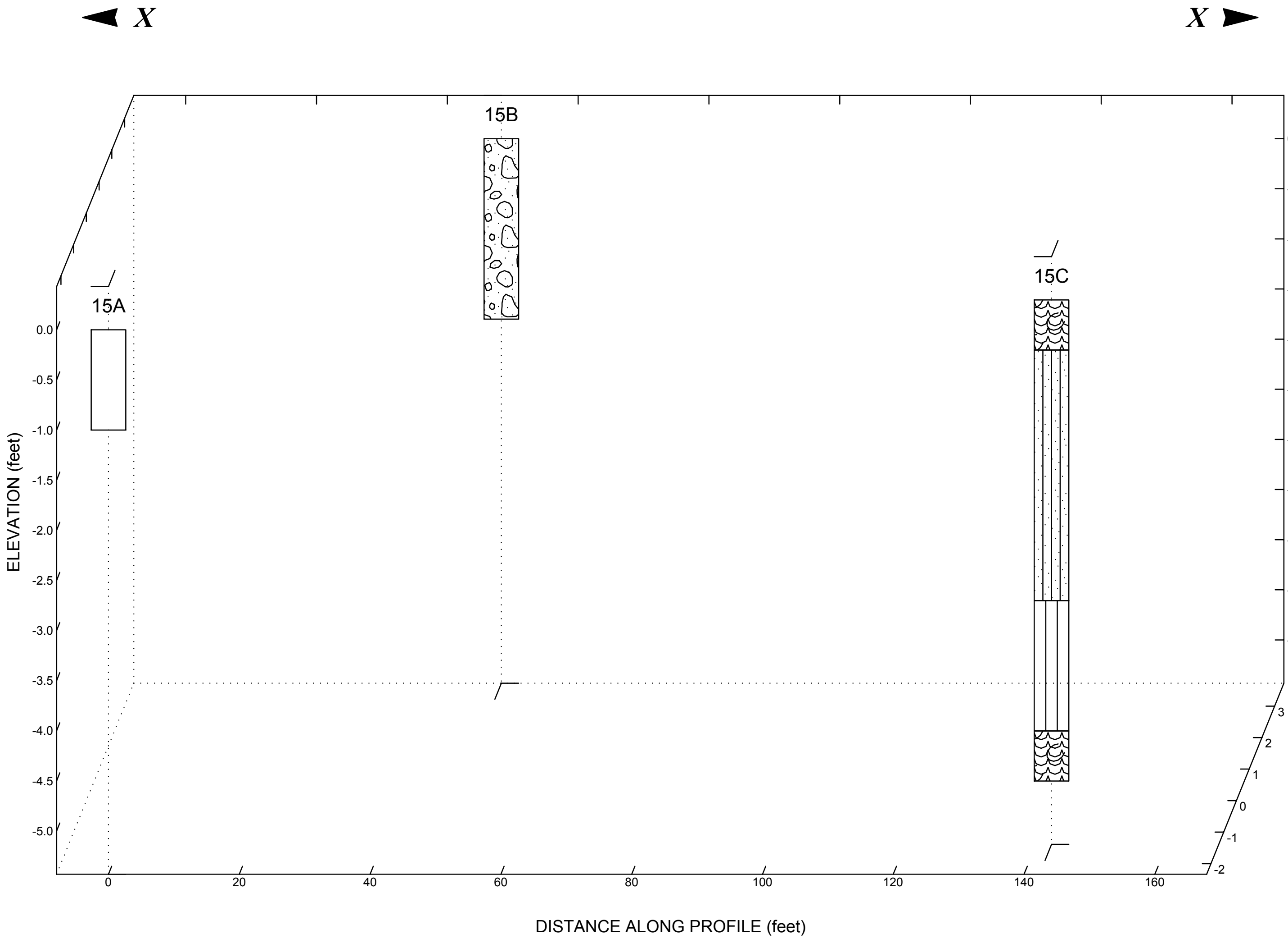
Malcolm Pirnie, Inc.

Location : Mile 14

MALCOLM PIRNIE

Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	14A - 14C



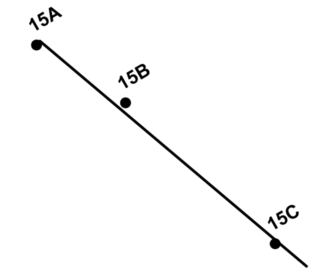
Lithology Graphics

Gravelly Sand

Organic silt or clay with shells

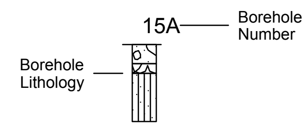
Silty Sand or Silt and Sand

Silt



Site Map Scale 1 inch equals 90 feet

Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.

Horizontal Scale (feet)

Vertical Exaggeration: 15.5x

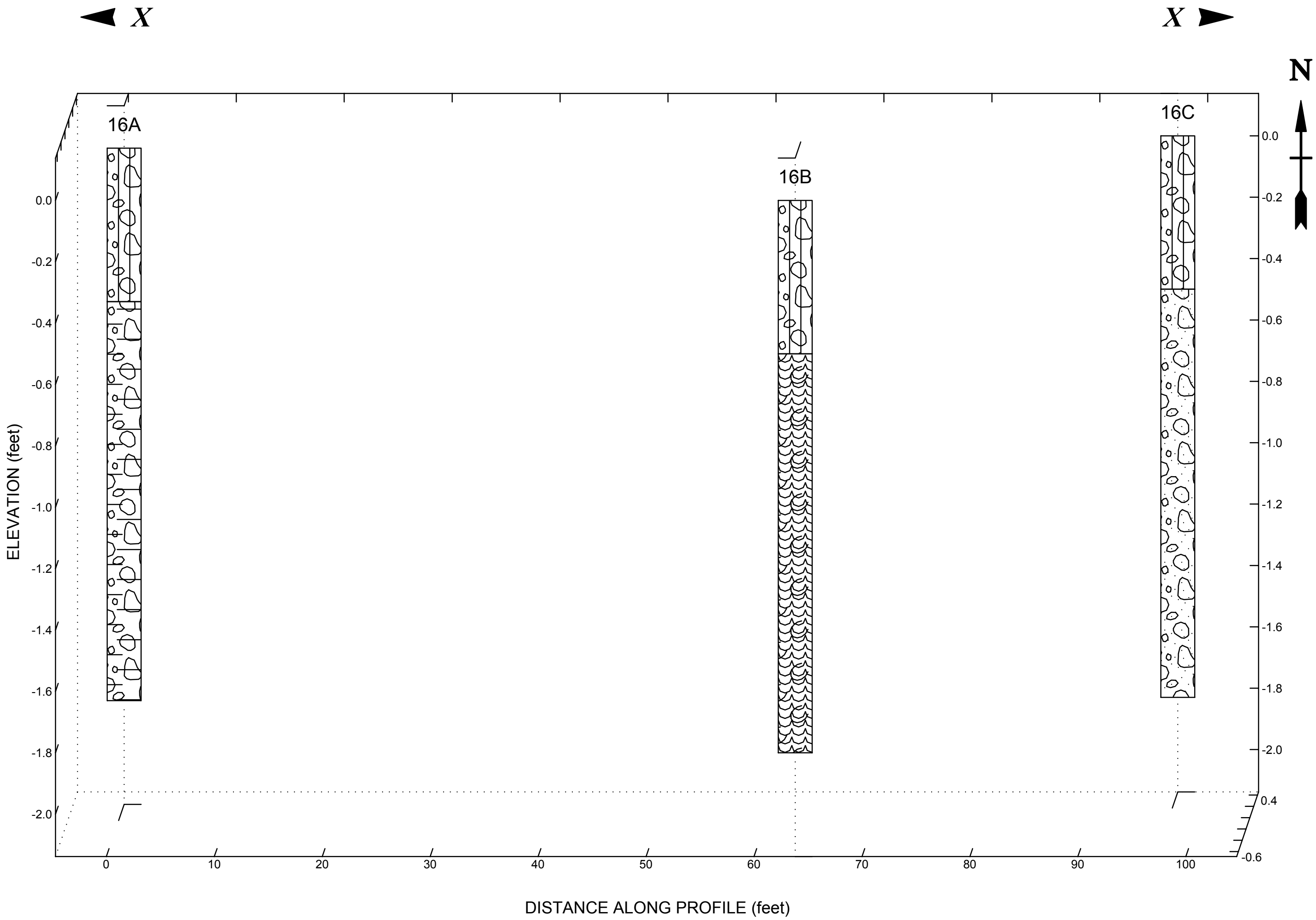
Malcolm Pirnie, Inc.

Location : Mile 15

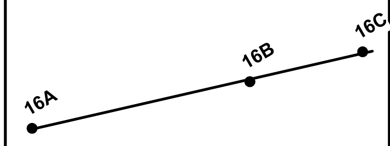
MALCOLM PIRNIE

Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	15A - 15C

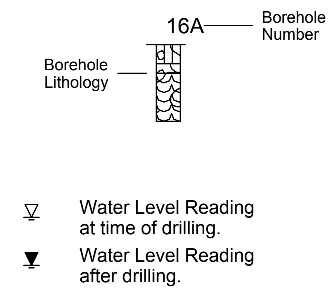


Lithology Graphics



Site Map Scale 1 inch equals 55 feet

Explanation



Horizontal Scale (feet)

Vertical Exaggeration: 28.5x

Malcolm Pirnie, Inc.

Location : Mile 16

MALCOLM PIRNIE

Lower Passaic River
New Jersey

JOB NUMBER	TRANSECT NUMBER
3473007	16A - 16C

Attachment 4: 2005 Sediment Sampling and Radiological Results

Malcolm Pirnie, Inc. report summarizing sediment samples collected in August and September 2005 from the Lower Passaic River and analyzed for radiological data, including beryllium-7 and cesium-137. This attachment includes tables and a one-mile-per-plate map book. Note that the map book only includes select river miles where samples were collected: RM 0-1, RM 1-2, RM 2-3, RM 3-4, RM 4-5, RM 6-7, RM 7-8, RM 9-10, RM 10-11, RM 12-13, RM 13-14, and RM 17-18.

1.0 INTRODUCTION

Surface sediment samples from the Lower Passaic River and Dundee Lake were collected and analyzed for Beryllium-7 (Be^7) to aid in selecting high resolution coring locations. This report describes the Be^7 sampling methodology, the results of the sediment analysis, and the subsequent high resolution coring location selection based on the Be^7 data, as well as other information.

Be^7 analysis is a common tool used to indicate recent sediment deposition since this radionuclide has a 54-day half-life. If Be^7 is detected in surface sediments, then it is likely that those sediments were deposited within the last 6 months, indicating that the site is depositional at the time of sample collection. Recent deposition was considered along with indicators of historic deposition in the selection of high resolution coring locations. As part of the Be^7 sampling effort, samples were also analyzed for Cesium-137 (Cs^{137}), whose concentration is an important component of the high resolution core dating process. Sites for Be^7 sample collection were identified from historical sediment core data, bathymetric surveys, the side scan sonar survey, and field observations.

2.0 METHODOLOGY

Surface sediment samples were collected from a depth of approximately 0-1 cm with an Eckman dredge that was equipped with a custom built Plexiglas liner, designed to prevent "slump" in the collected sediment sample. Sampling sites were located in 12 different target areas (TA) located between river mile (RM) 0 and RM 16 and from above Dundee Dam. [These target areas were previously identified in Figure 4-2 of the Field Sampling Plan Volume 1 (Malcolm Pirnie, Inc., 2005). Note that while 13 areas are presented in this figure, no surface sediment samples were collected from TA 12 due to coarse or rocky bottom.] Approximately three samples were collected from each target area (one sample from each of three sites per target area). Additional samples were obtained from other locations outside target areas where field conditions or existing data suggested a good high resolution coring location. The data sets used in identifying target areas and individual sampling sites included:

- Sediment texture information based on the side scan sonar survey.
- Sedimentation rates calculated using historical bathymetric data.
- Location of previously collected core samples with an interpretable Cs^{137} profile (e.g., Tierra Solution, Inc. 1995 historic dated cores).

Table 1 lists the surface sediment samples collected for analysis. These samples were analyzed for Be^7, Cs^{137}, and percent moisture. If during sampling, the site conditions were not found to be suitable for future core collection, sediment samples were not collected or retained for analysis. The most common reasons to abandon a site were:

- Coarse-grained sediment unlikely to be depositional.
- Sediment layer too thin to yield a good core.

- Leafy or other debris present at the sediment surface.

Table 2 is a listing of the locations that were occupied and subsequently abandoned during surface sediment sampling and the rationale behind abandonment.

3.0 DISCUSSION OF RESULTS

Be^7 concentrations from the surface samples ranged from non-detect to 9.71 picocuries per gram (pCi/g). The maximum concentration was obtained from Sample ID 001, near RM 12.3. Relatively high Be^7 concentrations were typically located north of RM 8 while relatively lower concentrations were typically located south of RM 8.

Cs^{137} concentrations from the surface samples ranged from non-detect to 0.714 pCi/g. The maximum concentration was obtained from Sample ID 031, located above Dundee Dam. Cs^{137} concentrations from samples collected above RM 15 tended to be lower than those samples collected below RM 15.

Percent moisture in the samples ranged from 42% in the sample collected from Sample ID 008 (located at RM 2) to 81% in the sample collected from Sample ID 029 (located at RM 9).

Analytical results are presented in Table 1. These results were evaluated in conjunction with sediment texture and calculated sedimentation rates. High resolution coring locations were then selected based on the most favorable combination of sediment texture, depositional rate, and recent radiological results. The desired attributes for each criterion included:

- Positive Be^7 detection and local concentration maxima.
- Cs^{137} concentration consistent with recent deposition (approximately 0.4 pCi/g or less).
- Classification as a fine sediment texture, preferably silt.
- Sediment deposition rate greater than 0 inches per year, but less than 5 inches per year because areas with a relatively high deposition rate were more likely to have been recently dredged.

Of these criteria, a high Be^7 concentration and the appropriate sediment type were the most important, followed by the desired calculated deposition rate, and an appropriate Cs^{137} concentration. Table 3 lists the surface sediment sample locations selected as final high resolution coring locations. Sampling locations are plotted on the attached sedimentation-rate maps. Note that each map sheet represents one river mile; sections of the river that do not contain a sampling location are not provided.

4.0 LOCATION CLASSIFICATION

Sediment sampling sites were classified into four categories, which are discussed below:

- High Resolution Coring Locations.
- Potential High Resolution Coring Locations.
- Additional Core Top Sampling Locations.
- No additional sample collection.

The rationale behind the selection of each location is described in the below sections.

4.1 HIGH RESOLUTION CORING LOCATIONS

4.1.1 Sample ID 005 at RM 1.05

Sample ID 005 is located in the northeastern section of TA 1 and in sediment classified as silt. Of the three samples collected in TA 1, Sample ID 005 had the highest Be^7 concentration (0.74 pCi/g) and was located in an area with a deposition rate of 2-3 inches per year. The detected Cs^{137} concentration in this sample (0.1 pCi/g) was also indicative of recently deposited sediments.

4.1.2 Sample ID 007 at RM 1.4

Sample ID 007 (associated with Tierra Solutions, Inc. location number BBL 209) is located towards the eastern river bank between TA 1 and TA 2 and sediment classified as silt with a deposition rate of 2-3 inches per year. Be^7 results for the sample (1.04 pCi/g) suggest recent deposition, and the detected Cs^{137} concentration (0.17 pCi/g) is also indicative of recently deposited sediments.

4.1.3 Sample ID 009 at RM 2.2

Sample ID 009 is located in the northwestern part of TA 2 in sediment that is classified as silt. This site is located on the border of two depositional areas with the average rate of 3 inches per year. Of the two samples collected in TA 2, Sample ID 009 had the highest Be^7 concentration (1.39 pCi/g), and the detected Cs^{137} concentration (0.12 pCi/g) is also indicative of recently deposited sediments.

4.1.4 Sample ID 010 at RM 2.6

Sample ID 010 (associated with Tierra Solutions, Inc. location number BBL 222) is located in the southern part of the navigation channel between TA 2 and TA 3 in sediment classified as silt with a deposition rate of 1-2 inches per year. Be^7 results for the sample (0.85 pCi/g) and the detected Cs^{137} concentration (0.12 pCi/g) indicate that sediments were recently deposited.

4.1.5 Sample ID 017 at RM 3.5

Sample ID 017 (associated with Tierra Solutions, Inc. location number BBL 235) is located in the northern part of the navigation channel between TA 3 and TA 4 in sediment classified as silt and at the edge of an area with a deposition rate of 0-1 inches per year. The detected Be^7 concentration (0.64 pCi/g) in Sample ID 017 was the highest of the three samples collected in TA 3, and the Cs^{137} concentration (0.19 pCi/g), is indicative of recently deposited sediments.

4.1.6 Sample ID 018 at RM 4.1

Sample ID 018 is located in the northwestern part of TA 4 in sediment classified as silt. A deposition rate could not be calculated from the historical data for this specific location, but the sampling point is at the edge of an area with a deposition rate of 0-1 inches per year. The detected Be^7 concentration (1.34 pCi/g) in Sample ID 018 was the highest of the three samples collected in TA 4, and the Cs^{137} concentration (0.19 pCi/g) is indicative of recent deposition.

4.1.7 Sample ID 024 at RM 6.4

Sample ID 024 is located in the southwestern part of TA 6 in sediment classified as silt with a deposition rate of 1-2 inches per year. The detected Be^7 (0.818 pCi/g) and the Cs^{137} (0.13 pCi/g) concentrations are indicative of recent deposition.

4.1.8 Sample ID 026 at RM 7.8

Sample ID 026 is located in the middle of TA 7 in sediment classified as silt. A deposition rate could not be calculated from the historical data for that specific location, but the sampling point is at the edge of an area with a deposition rate of 0-1 inches per year. The detected Be^7 (2.47 pCi/g) and Cs^{137} (0.2 pCi/g) concentrations are indicative of recent deposition.

4.1.9 Sample ID 013 at RM 10.0

Sample ID 013 is located in the northern part of TA 8 in an area classified as silt with a deposition rate of 2-3 inches per year. The detected Be^7 concentration (5.85 pCi/g) was the highest of the three samples collected in TA 8, and the detected Cs^{137} concentration (0.22) is also indicative of recent deposition.

4.1.10 Sample ID 028 at RM10.8

Sample ID 028 is located just outside of the TA 9 border to the south, between TA 8 and TA 9, in an area classified as silt with a deposition rate of 0-1 inches per year. The detected Be^7 (4.82 pCi/g) and Cs^{137} (0.241 pCi/g) concentrations are indicative of recent deposition.

4.1.11 Sample ID 029 at RM 11.0

Sample ID 029 is located in the southwestern part of TA 9 in an area classified as silt. While the historical deposition rate calculated for this area is -1 to 0 inches per year, the detected Be^7 (5.88 pCi/g) and Cs^{137} (0.306 pCi/g) concentrations are indicative of recent deposition. Note that the site is also located on the edge of an area with a deposition rate of 0-1 inches per year.

4.1.12 Sample ID 001 at RM 12.3

Sample ID 001 is located on the southern border of TA 10 in sediment classified as silt with a deposition rate of 2-3 inches per year. The detected Be^7 concentration (9.71 pCi/g) was the highest of the three samples collected in the TA 10 area, and the detected Cs^{137} (0.29 pCi/g) concentration is also indicative of recent deposition.

4.1.13 Sample ID 032 at RM 12.6

Sample ID 032 is located in the middle of TA 10 in sediment with a deposition rate of 0-1 inches per year. Historical classification suggests that the area is composed of rock and coarse gravel, but field observation of the sample collected indicated that the material consisted of sandy silt with approximately 20% sand. The detected Be^7 concentration (3.01 pCi/g) was the second highest of the three samples collected in the TA 10 area, and the detected Cs^{137} concentration (0.132 pCi/g) is consistent with recent deposition.

4.1.14 Sample ID 037 at RM 18.0

Sample ID 037 is located above the Dundee Dam near approximately RM 18. No historical information is available for this site, but field observation of the collected material indicated that the sediment consisted of silt with 15-20% fine sand. The detected Be^7 concentration (1.6 pCi.g) was the highest of the five samples collected above Dundee Dam. The detected Cs^{137} concentration (0.089 pCi/g) is consistent with recent deposition.

4.1.15 Sample ID 035 at RM 17.0

Sample ID 035 is also located above the Dundee Dam, southwest of Sample ID 037. No historical information is available for this site, but field observations of the collected material indicated that the sediment consisted of sandy silt with approximately 10-15% fine sand and 10-15% organic debris. The detected Be^7 concentration (0.89 pCi/g) was the second highest of the five samples collected above Dundee Dam, and the detected Cs^{137} concentration (0.148 pCi/g) is consistent with recent deposition.

4.2 POTENTIAL HIGH RESOLUTION CORING LOCATIONS

The following four sampling sites were identified as potential high resolution coring locations. These potential locations were established to serve as “back-up locations” in the event that a high-resolution core was not successfully obtained from the 15 primary coring locations. Potential locations would only be used to replace a local coring site (*e.g.*, Sample ID 006 might replace Sample ID 005). Information pertaining to these sites is summarized in the table below.

Sample ID	River Mile	Target Area	Sedimentation Rate (in/year)	Be-7 (pCi/g)	Cs-137 (pCi/g)	Notes
006	1.2	1	Border of 4-5 and >5	0.73	0.10	Recent deposition
020	3.8	4	0-1	0.54	0.12	Recent deposition
012	9.9	8	2-3	4.39	0.19	Recent deposition
031	12.5	10	Border of (-1)-0 and 0-1	3.13	0.71	Not continuously depositional

While in the field, a center channel station was also defined in TA 1 as a potential sampling location in the event that a successful high resolution core could not be collected from Sample ID 005 or Sample ID 006. No surface sediment core was collected from this area during the Be^7 program. This site was selected base on field observations and deposition rate calculations.

4.3 Additional Core Top Sampling

4.3.1 Sample ID 002 at RM 14.0

Sample ID 002 is located in the eastern part of TA 11 in sediment classified as silt and sand with a deposition rate of 1-2 inches per year. While the detected Be^7 level (5.08 pCi/g) was relatively high, the Cs^{137} level (0.07 pCi/g) was considered too low to be indicative of a site with continuous deposition. Sample ID 002 was not identified as a potential high resolution coring location; however, this site was identified for future core top sampling. Core top samples (0-1 cm) will be analyzed for a suite of chemicals to determine the contamination concentration in recently deposited sediments.

4.4 Locations Not Selected for Additional Sampling

The following sample locations were not selected for additional sample collection:

- Sample ID 003
- Sample ID 004
- Sample ID 008
- Sample ID 011
- Sample ID 014
- Sample ID 015
- Sample ID 016
- Sample ID 019
- Sample ID 021
- Sample ID 022
- Sample ID 023
- Sample ID 034
- Sample ID 036
- Sample ID 036 dup
- Sample ID 038

Table 1

Be^7 Sampling Locations

Field Sample ID	PREmis Sample ID	Date Collected	Time Collected	Water Depth (ft)	Probe Depth (ft)	Northing	Easting	Be-7 (pCi/g)	Be-7 error (+/-) (pCi/g)	Cs-137 (pCi/g)	Cs-137 error (+/-) (pCi/g)	Percent Moisture (%)	River Mile	Target Area	Associated BBL location	Description and Comments
001	LPRP-SCSS-PSR-000020	08/29/2005	03:15:00PM	8	4.5	728363.9	596911.9	9.71	2.75	0.29	0.038	62.80	12.3	10		Gray silt with trace fine sand
002	LPRP-SCSS-PSR-000021	08/29/2005	04:30:00PM	11.5	6	737051.2	597369.9	5.08	1.43	0.07	0.026	64.20	14.0	11		Dark brown, low plasticity silt with approx. 30% fine sand
003	LPRP-SCSS-PSR-000022	08/30/2005	10:05:00AM	9.5		688848.4	597504.8	0.531	0.240	0.133	0.018	48.10	1.00	1		Brownish gray low plasticity silt with trace fine sand
004	LPRP-SCSS-PSR-000023	08/30/2005	10:15:00AM	9		689076.8	597585.6	0.409	0.123	0.097	0.016	61.20	1.03	1		Brownish gray low plasticity silt with trace fine sand
005	LPRP-SCSS-PSR-000024	08/30/2005	10:50:00AM	8		689423.9	597694.4	0.738	0.244	0.148	0.017	64.60	1.05	1		Brownish gray low plasticity silt with trace fine sand; organic material observed
006	LPRP-SCSS-PSR-000025	08/30/2005	11:05:00AM	8	> 8	689974.3	597313.8	0.729	0.239	0.100	0.016	59.10	1.2	1		Brownish gray low plasticity silt with trace fine sand
007	LPRP-SCSS-PSR-000027	08/30/2005	11:30:00AM	9 to 10		691134.5	598082.7	1.04	0.325	0.169	0.069	64.20	1.4	bet 1, 2	209	Brown-gray silt with approx. 15% fine sand and trace organics; strong sewage odor
008	LPRP-SCSS-PSR-000028	08/30/2005	12:00:00PM	11	5	693995.4	598123.4	0.443	0.244	0.094	0.011	42.10	2.0			Brown-gray silt with approx. 15% fine sand and trace organics; strong sewage odor
009	LPRP-SCSS-PSR-000029	08/30/2005	12:20:00PM	4	> 7.5	694855.0	597581.8	1.39	0.401	0.124	0.029	76.20	2.2	2		Dark brown silt with approx. 15% fine sand and 10-20% organic debris
010	LPRP-SCSS-PSR-000030	08/30/2005	01:05:00PM	12	> 6	695468.4	595394.1	0.852	0.252	0.120	0.014	61.90	2.6	bet 2,4	222	Brownish gray silt with trace fine sand and approx 15% organic debris; hard crust felt during probing
011	LPRP-SCSS-PSR-000031	08/30/2005	03:55:00PM	7	> 6	717395.0	592093.0	1.020	0.293	0.106	0.010	50.30	9.8	8		Brownish gray silt with 30% fine sand
012	LPRP-SCSS-PSR-000032	08/30/2005	04:15:00PM	5		718091.0	591954.0	4.390	1.230	0.189	0.053	75.80	9.9	8		Brownish green low plasticity silt with trace fine sand; high water content
013	LPRP-SCSS-PSR-000033	08/30/2005	04:30:00PM	7	> 8	718844.0	592139.0	5.850	1.630	0.224	0.018	78.80	10.0	8		Brownish green low plasticity silt with trave fine sand; high water content; probe tight at bottom
014	LPRP-SCSS-PSR-000034	09/01/2005	11:00:00AM	19	> 4	695347.0	593116.0	0.276	0.077	0.203	0.020	67.40	3.1	3	230	Gray-black, low plasticity silt with trace clay; slight odor
015	LPRP-SCSS-PSR-000035	09/01/2005	11:40:00AM	12	> 6	695235.0	593232.0	0.210	0.095	0.135	0.013	55.20	3.1	3	228	Dark brown-black silt with trace clay; significant organic matter (leaves, twigs, roots) retrieved with samples
016	LPRP-SCSS-PSR-000036	09/01/2005	12:05:00PM	15	> 3 to 4	695521.0	393692.0	0.225	0.077	0.173	0.011	63.80	2.9	3		Brownish silt with trace clay and 10-20 % sand
017	LPRP-SCSS-PSR-000037	09/01/2005	01:00:00PM	15	> 4	694335.0	591088.0	0.637	0.193	0.350	0.033	63.80	3.5	bet 3,4	235	Grayish-black silt with little sand, trace clay, and trace organic debris
018	LPRP-SCSS-PSR-000038	09/01/2005	01:35:00PM	6	8	692630.0	589232.0	1.340	0.374	0.185	0.015	42.50	4.1	4	241 (ballpark)	Brownish black silt with trace clay and trace to little leaf litter
019	LPRP-SCSS-PSR-000039	09/01/2005	02:10:00PM	18	soft	692312.0	589331.0	0.139	0.039	0.104	0.018	46.30	4.1	4		Brownish black silt with trace clay, little fine sand, and little coarse sand
020	LPRP-SCSS-PSR-000040	09/01/2005	02:35:00PM	17	soft	692949.0	590463.0	0.541	0.169	0.124	0.014	49.10	3.8	4		Grayish brown silt
021	LPRP-SCSS-PSR-000041	09/01/2005	03:15:00PM	8	soft	692971.0	586227.0	0.011	0.008	0.142	0.026	60.20	4.7	5	251	Dark brownish black silt with trace clay and little to trace sand
022	LPRP-SCSS-PSR-000042	09/06/2005	09:40:00AM	16	> 4	694051.1	585621.2	0.217	0.095	0.134	0.020	55.00	4.9	5		Brown-gray silt with approx. 10% fine sand
023	LPRP-SCSS-PSR-000043	09/02/2005	10:10:00AM	17.5	> 3	694785.9	585416.3	0.376	0.140	0.123	0.013	51.10	5.1	5		Grayish-black silt with approx. 10% fine sand; sulfur (rotten eggs) odor
024	LPRP-SCSS-PSR-000044	09/02/2005	11:05:00AM	13	4	701755.2	585490.1	0.818	0.235	0.130	0.140	45.20	6.4	6		Silt with at least 30% sand
026*	LPRP-SCSS-PSR-000045	09/02/2005	12:35:00PM	12	3	708047.0	588852.0	2.470	0.698	0.200	0.020	66.20	7.8	7		Dartk brown silt with trace fine sand
028	LPRP-SCSS-PSR-000046	09/02/2005	01:55:00PM	5	> 4	722786.7	592666.5	4.820	1.340	0.241	0.024	75.80	10.8	9		Greenish brown low plasticity silt with trace fine sand
029	LPRP-SCSS-PSR-000047	09/02/2005	02:45:00PM	4.5	> 5	723366.3	593419.6	5.880	1.630	0.306	0.029	80.50	11.0	9		Greenish brown low plasticity silt with trace fine sand
031	LPRP-SCSS-PSR-000048	09/02/2005	03:20:00PM	8.5	4	729263.2	596532.5	3.130	0.883	0.714	0.050	70.00	12.5	10		Brownish green low plasticity silt with trace fine sand and trace clay
032	LPRP-SCSS-PSR-000049	09/02/2005	03:55:00PM	6	soft silt	729624.2	596399.6	3.010	0.842	0.132	0.011	61.80	12.6	10		Brownish sandy silt with 20% fine sand; sample collected in 3 feet of water
034	LPRP-SCSS-PSR-000050	09/06/2005	03:10:00PM	5	> 3	747318.0	594381.0	0.001	0.001	0.009	0.005	59.50	17.0	above DD		Dark brown sandy silt with approx. 30% fine sand and trace organic debris
035	LPRP-SCSS-PSR-000051	09/06/2005	03:40:00PM	4	> 5	747930.0	594041.0	0.890	0.257	0.148	0.012	61.60	17.0	above DD	01A	Dark brown sandy silt with approx. 10-15% fine sand and approx. 10-15% organic debris
036	LPRP-SCSS-PSR-000052	09/06/2005	04:40:00PM	1	3	747660.0	594325.0	0.169	0.094	0.122	0.021	45.10	17.0	above DD		Dark brown silt with approx. 30% fine sand
036 dup	LPRP-SCSS-PSR-000053	09/06/2005	04:45:00PM	1	3	747660.0	594325.0	0.348	0.107	0.084	0.015	42.60	17.0	above DD		Dark brown silt with approx. 30% fine sand
037	LPRP-SCSS-PSR-000055	09/08/2005	09:35:00AM	6	> 3 to 4	750527.0	594773.0	1.600	0.451	0.089	0.008	59.10	18.0	above DD		Brown silt with 15-20% fine sand; petroleum odor
038	LPRP-SCSS-PSR-000056	09/08/2005	09:55:00AM	5	4	750910.0	594653.0	0.464	0.161	0.043	0.007	46.00	18.0	above DD		Brown silt with 10-20% fine sand; petroleum odor (slightly stronger than that at 037)

Note:

* GPS not working, coordinates are approximate

Table 2

Abandoned Potential Be^7 Sampling Locations

Field ID	Date	Time	Water Depth (ft)	Probe Depth (ft)	Northing	Easting	Target Area	Sample/Probe	Reason for Abandonment
008	8/30/2005	11:45	5		698772.7	598104.9		sample	Too much organic material to collect a silt sample
018	9/1/2005	13:15	8	> 7	692573.0	589490.0	4	sample	Leaf litter obtained; silt could not be collected
019	9/1/2005	13:45	5	> 6	692695.0	589859.0	4	sample	Leaf litter obtained; silt could not be collected
021A	9/2/2005	10:00	16	> 4	694061.0	585634.9	5	probe	Silt over sandy bottom
024A	9/2/2005	10:30	10	4	701000	585250	6	sample	Was not able to retrieve sediment
024	9/2/2005	10:40	9	4	701255.84	585364.57	6	probe	< than three feet of mud
025	9/2/2005	11:20		< 3	703700	586511		probe	< than three feet of mud
025	9/2/2005		18		704028.56	586971.82		probe	18 ft of water and gravel
025	9/2/2005	11:35	10	4	704537.08	587224.4		probe	Boat drifted
025	9/2/2005	11:51	7	3	704712.65	587303.88		probe	Spotty mud
026	9/2/2005				708200	589000	7	probe	Sandy
027	9/2/2005	12:45	3.5	3.5	707460.56	588320.63		probe	Silt underlain by sand
027	9/2/2005				707416	588323		probe	Hard bottom
029	9/2/2005		4.5	5	723427.6	593351	8	probe	Sandy bottom
030	9/2/2005				723558.6	593861.73		probe	Sand
030	9/2/2005				723505.9	53382.75		probe	2.5 ft of mud
033	9/2/2005	16:20			737600	597392	11	probe	sand
033	9/2/2005		3.5	1	737817	597498	11	probe	only 1' silt
033	9/2/2005				738184	597689	11	probe	sand
033	9/2/2005				738268.58	597916.5	11	probe	sand
033	9/2/2005				738310	598793	11	probe	Sand
033	9/2/2005		approx 3		737353.27	599360.63	11	probe	Sand with a little bit of silt
036A	9/6/2005	16:00	2	> 4 silt	748178	594317	above DD	sample	Sandy material retrieved
036B	9/6/2005	16:10	1	> 2	747990	594345	above DD	sample	Sandy material retrieved
036C	9/6/2005	16:15		sand	749158	594500	above DD	probe	Sandy material retrieved
036D	9/6/2005	16:20	> 10	sand	749078	594773	above DD	probe	Sandy material retrieved
037A	9/7/2005	9:05	2	4 soft	749477	594432	above DD	sample	First drop didn't release properly; second yielded sand
037B	9/7/2005	9:10	> 2	sand	749454	594795	above DD	probe	Sand
037C	9/7/2005	9:15	deep	sand	749521	594857	above DD	probe	Sand
037D	9/7/2005	9:20	8	sand	749770	594720	above DD	probe	Sand
039	9/7/2005	10:00		cs	750940	594397	above DD	probe	Coarse sand
040A	9/7/2005	14:30	3.5	cs, gr, rock	742348	598920	12	probe	Coarse sand, gravel, and rock
040B	9/7/2005	14:35	3	rock, gr	742077	598817	12	probe	Rock and gravel
040C	9/7/2005	14:40	4	rock, gr	741987	598998	12	probe	Rock and gravel
040D	9/7/2005	14:43	4	rock	741803	599203	12	probe	Rock
040E	9/7/2005	14:44	5	rock	741726	399175	12	probe	Rock
040F	9/7/2005	14:46	9	rock, gr	741474	599440	12	probe	Rock and gravel
040G	9/7/2005	14:47	5	rock	741411	599358	12	probe	Rock
040H	9/7/2005	14:48	4.5	rock	741119	599422	12	probe	Rock
040I	9/7/2005	14:49	5.5	rock	741097	599551	12	probe	Rock
040J	9/7/2005	14:53	5.5	rock	740436	599623	12	probe	Rock
040K	9/7/2005	14:55	5.5	gr, rock	740259	599866	12	probe	Gravel and rock
040L	9/7/2005	14:56			740060	600114	12	probe	Too deep to probe
040M	9/7/2005	14:48	6.5	rock	740059	600263	12	probe	Rock
040N	9/7/2005	15:00	5	rock	739657	600538	12	probe	Rock
040O	9/7/2005	15:02	3.5	rock	739643	600699	12	probe	Rock

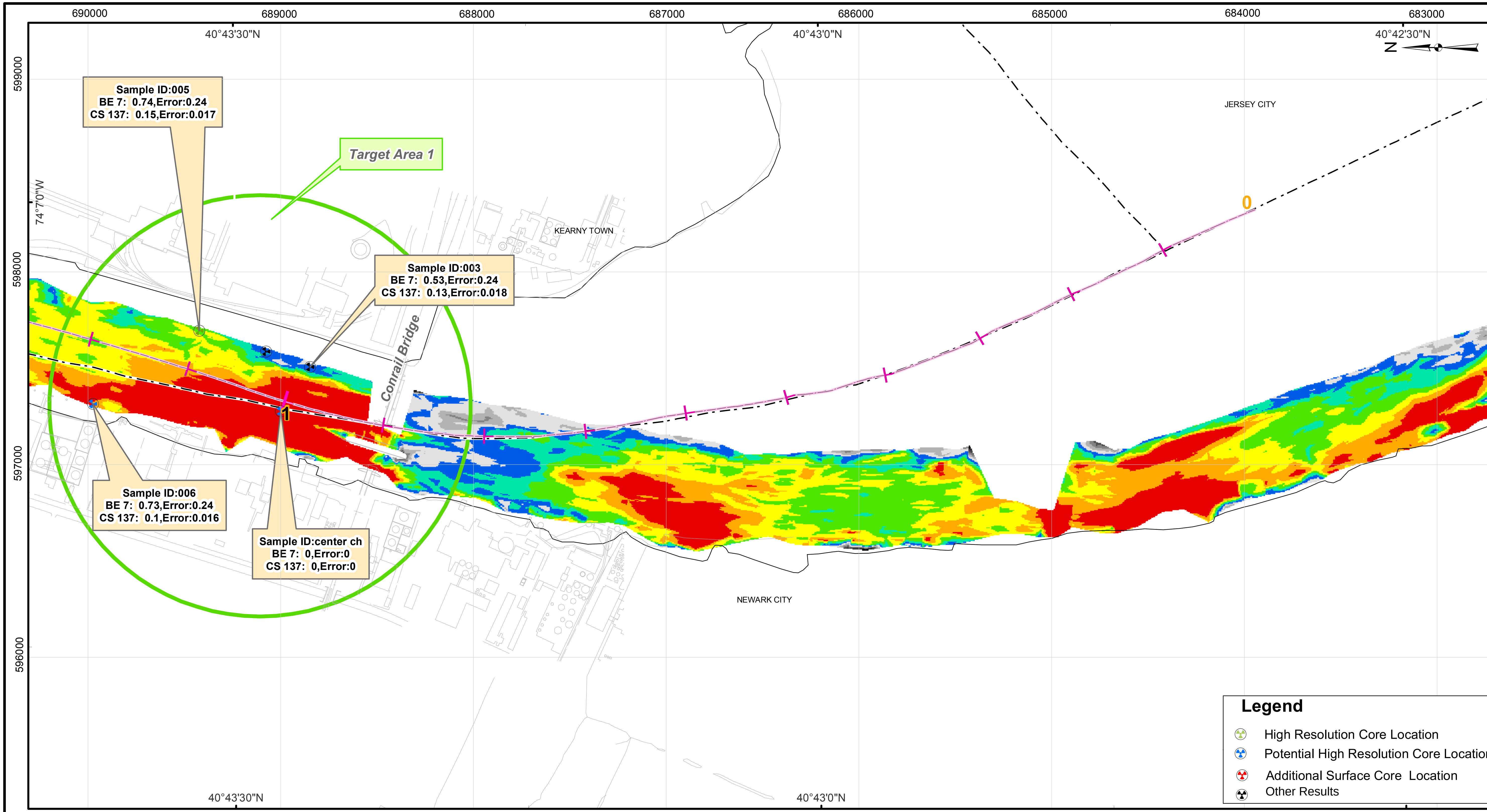
Total abandoned locations = 47

Table 3
High Resolution Core Sites

Sample Type	Field Sample ID	Water Depth (ft)	Probe Depth (ft)	Northing	Easting	Be-7 (pCi/g)	Be-7 error (+/-) (pCi/g)	Cs-137 (pCi/g)	Cs-137 error (+/-) (pCi/g)	Percent Moisture (%)	River Mile	Target Area	Associated BBL location	Description and Comments
core	**005**	**8**		**689423.9**	**597694.4**	**0.738**	**0.244**	**0.148**	**0.017**	**64.60**	**1.05**	**1**		Brownish gray low plasticity silt with trace fine sand; organic material observed
potential location	006	8	> 8	689974.3	597313.8	0.729	0.239	0.100	0.016	59.10	1.2	1		Brownish gray low plasticity silt with trace fine sand
potential location	center channel			689000.0	597275.0							1		Center channed station not sampled during the Be-7 program.
core	**007***	**9 to 10**		**691134.5**	**598082.7**	**1.04**	**0.325**	**0.169**	**0.069**	**64.20**	**1.4**	**bet 1, 2**	**209**	Brown-gray silt with approx. 15% fine sand and trace organics; strong sewage odor
core	**009**	**4**	**> 7.5**	**694855.0**	**597581.8**	**1.39**	**0.401**	**0.124**	**0.029**	**76.20**	**2.2**	**2**		Dark brown silt with approx. 15% fine sand and 10-20% organic debris
core	**010***	**12**	**> 6**	**695468.4**	**595394.1**	**0.852**	**0.252**	**0.120**	**0.014**	**61.90**	**2.6**	**bet 2,3**	**222**	Brownish gray silt with trace fine sand and approx 15% organic debris; hard crust felt during probing
core	**017***	**15**	**> 4**	**694335.0**	**591088.0**	**0.637**	**0.193**	**0.350**	**0.033**	**63.80**	**3.5**	**bet 3,4**	**235**	Grayish-black silt with little sand, trace clay, and trace organic debris
core	**018***	**6**	**8**	**692630.0**	**589232.0**	**1.340**	**0.374**	**0.185**	**0.015**	**42.50**	**4.1**	**4**	**241**	Brownish black silt with trace clay and trace to little leaf litter
potential location	020	17	soft	692949.0	590463.0	0.541	0.169	0.124	0.014	49.10	3.8	4		Grayish brown silt
core	**024**	**13**	**4**	**701755.2**	**585490.1**	**0.818**	**0.235**	**0.130**	**0.140**	**45.20**	**6.4**	**6**		**Silt with at least 30% sand**
core	**026***	**12**	**3**	**708047.0**	**588852.0**	**2.470**	**0.698**	**0.200**	**0.020**	**66.20**	**7.8**	**7**		**Dartk brown silt with trace fine sand**
core	**013**	**7**	**> 8**	**718844.0**	**592139.0**	**5.850**	**1.630**	**0.224**	**0.018**	**78.80**	**10.0**	**8**		Brownish green low plasticity silt with trave fine sand; high water content; probe tight at bottom
potential location	012	5		718091.0	591954.0	4.390	1.230	0.189	0.053	75.80	9.9	8		Brownish green low plasticity silt with trace fine sand; high water content
core	**028**	**5**	**> 4**	**722786.7**	**592666.5**	**4.820**	**1.340**	**0.241**	**0.024**	**75.80**	**10.8**	**9**		**Greenish brown low plasticity silt with trace fine sand**
core	**029**	**4.5**	**> 5**	**723366.3**	**593419.6**	**5.880**	**1.630**	**0.306**	**0.029**	**80.50**	**11.0**	**9**		**Greenish brown low plasticity silt with trace fine sand**
core	**001**	**8**	**4.5**	**728363.9**	**596911.9**	**9.71**	**2.75**	**0.29**	**0.038**	**62.80**	**12.3**	**10**		Gray silt with trace fine sand
core	**032**	**6**	**soft silt**	**729624.2**	**596399.6**	**3.010**	**0.842**	**0.132**	**0.011**	**61.80**	**12.6**	**10**		**Brownish sandy silt with 20% fine sand; sample collected in 3 feet of water**
potential location	031	8.5	4	729263.2	596532.5	3.130	0.883	0.714	0.050	70.00	12.5	10		Brownish green low plasticity silt with trace fine sand and trace clay
core top	002	11.5	6	737051.2	597369.9	5.08	1.43	0.07	0.026	64.20	14.0	11		Dark brown, low plasticity silt with approx. 30% fine sand
core	**035**	**4**	**> 5**	**747930.0**	**594041.0**	**0.890**	**0.257**	**0.148**	**0.012**	**61.60**	**17.0**	**above DD**	**01A**	**Dark brown sandy silt with approx. 10-15% fine sand and approx. 10-15% organic debris**
core	**037**	**6**	**> 3 to 4**	**750527.0**	**594773.0**	**1.600**	**0.451**	**0.089**	**0.008**	**59.10**	**18.0**	**above DD**		**Brown silt with 15-20% fine sand; petroleum odor**

NOTES:
Potential locations are alternate spots to collect a sample if the defined core location cannot be successfully sampled.
DoC = depth of contamination

Field Sample ID	Note
007	Near BBL ID 209. Cs-137 extends to 5 ft. Anticipated DoC of 10 ft.
010	Near BBL ID 222. Cs-137 extends to 11.5 ft. Anticipated DoC of 23 ft.
017	Near BBL ID 235. Cs-137 extends to 6.5 ft. Anticipated DoC of 13 ft.
018	Near BBL ID 241. Cs-137 extends to 8.5 ft. Anticipated DoC of 16 ft.
01A	



US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004)

Legend

Sedimentation Rate
Inches per Year

- < -5
- -5 to -4
- -4 to -3
- -3 to -2
- -2 to -1
- -1 to 0
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- > 5

\+ BBL Data

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '

Mile 0 to 1

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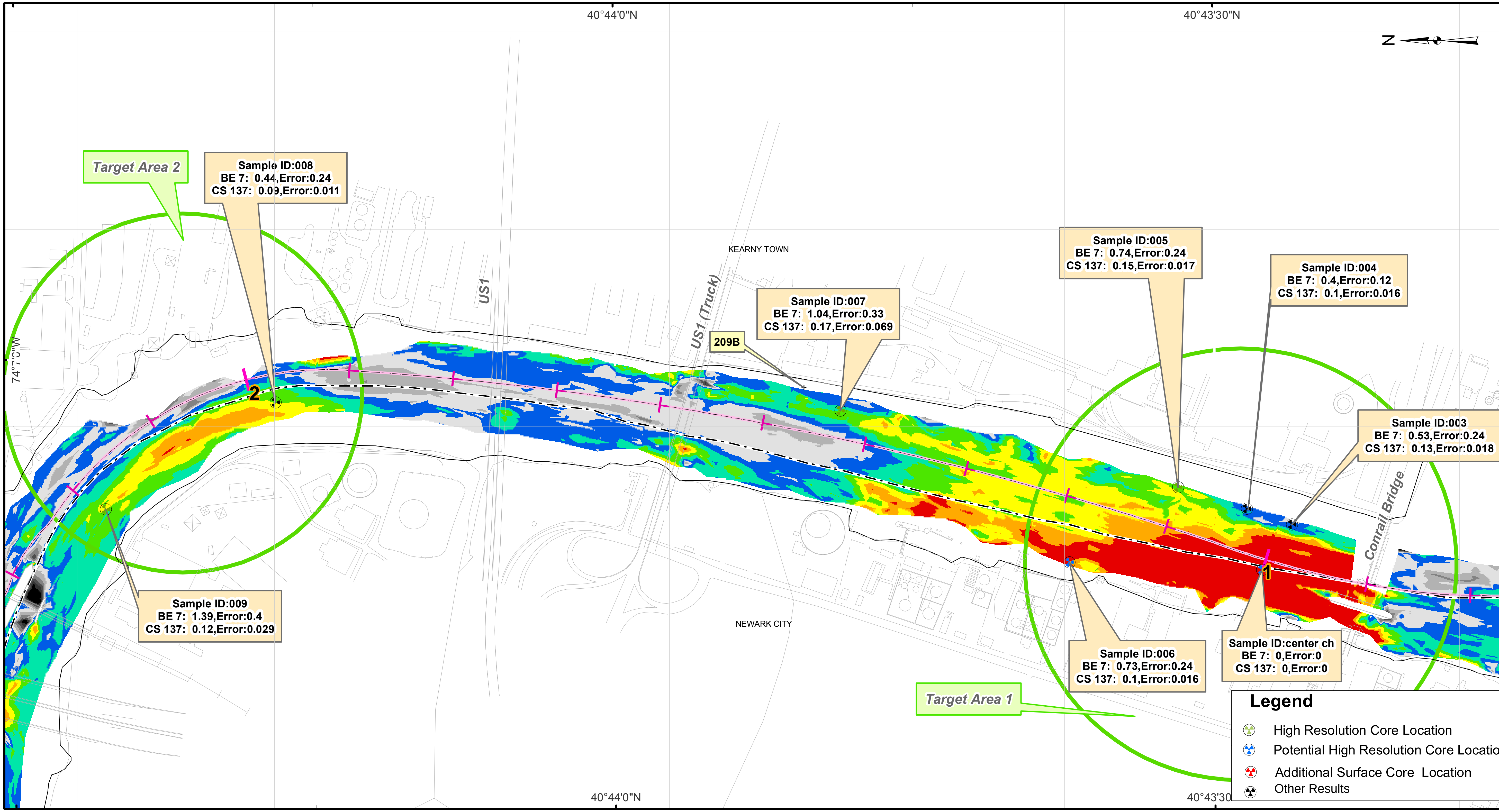

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US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate
(1989-2004)

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

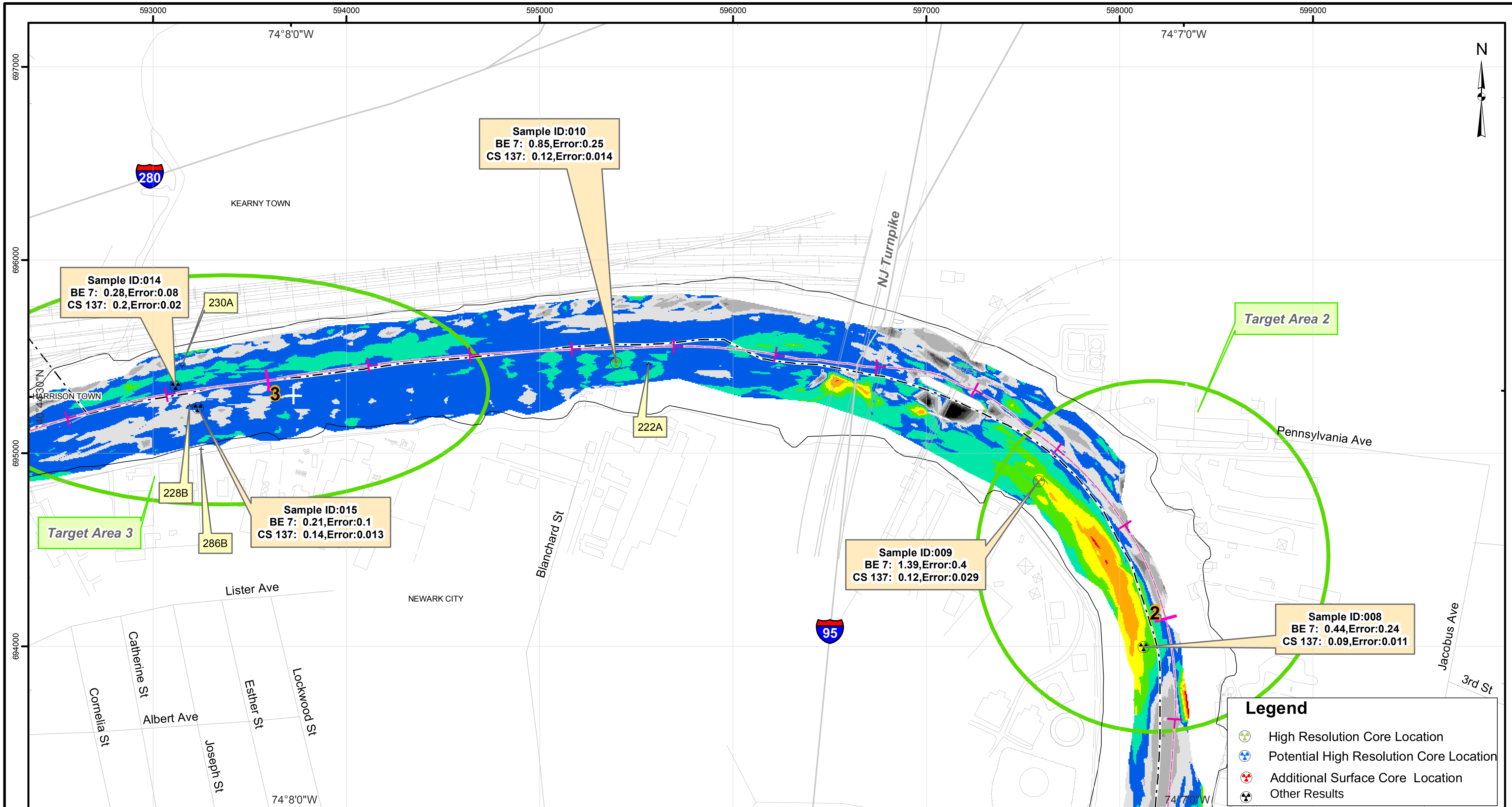
+ BBL Data
River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '

Mile 1 to 2



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US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004)

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

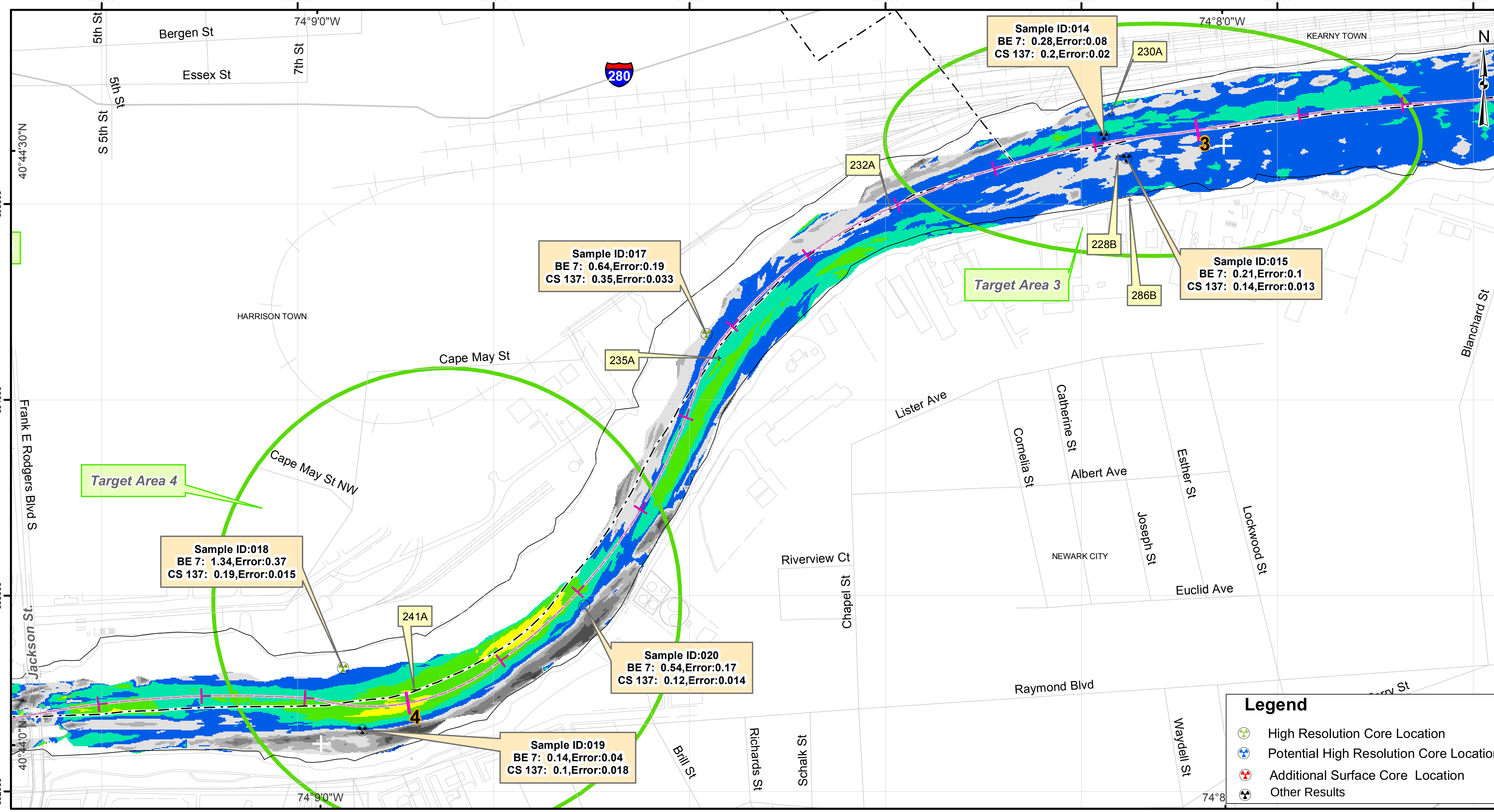
+ BBL Data
River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '

Mile 2 to 3



Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004)

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

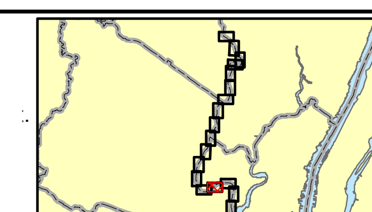
+ BBL Data

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '



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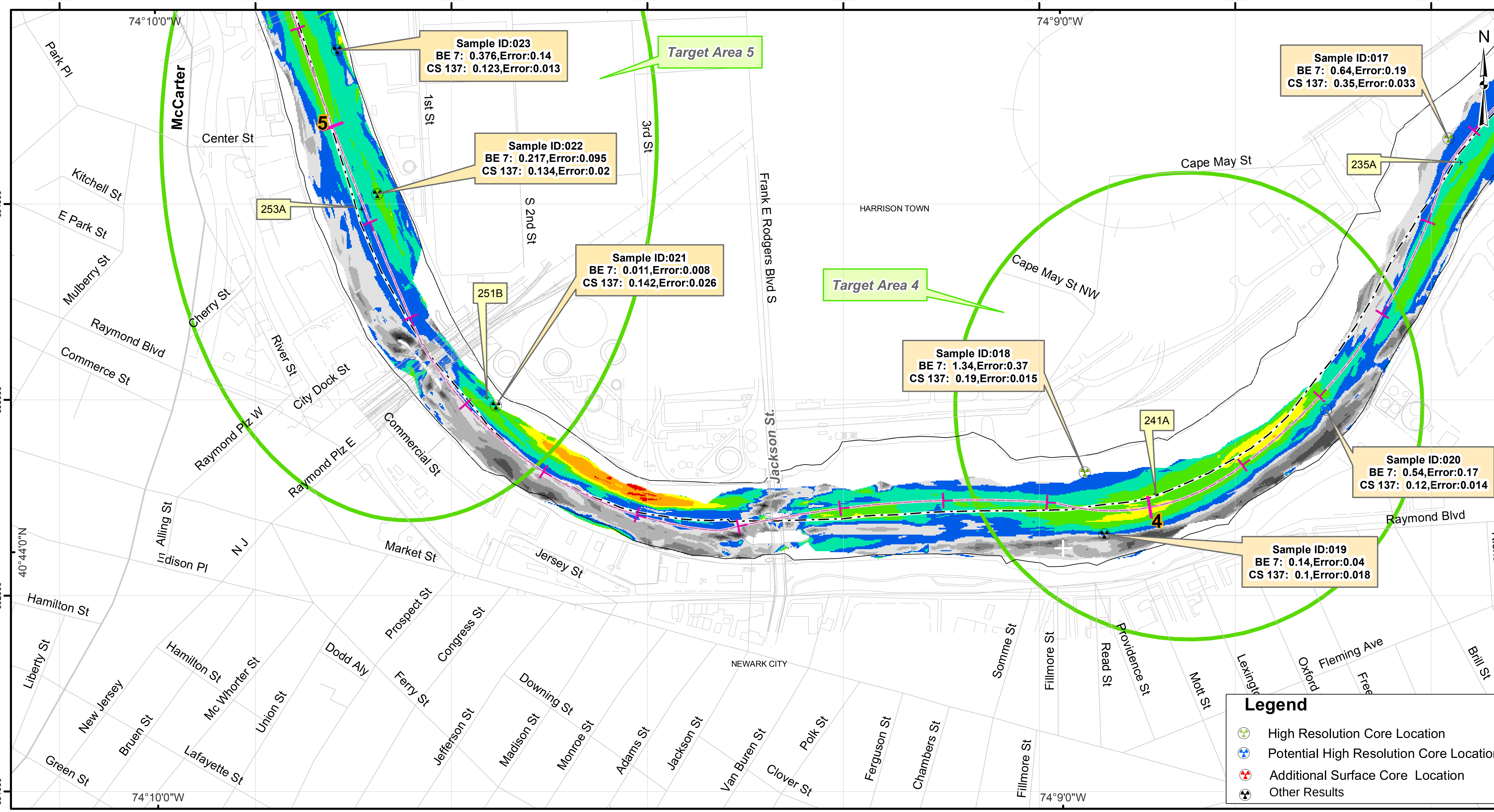


US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004)

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

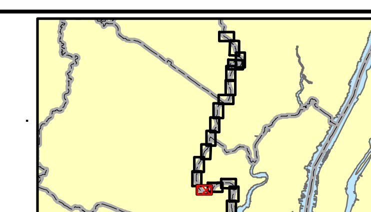
+ BBL Data

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '



Mile 4 to 5

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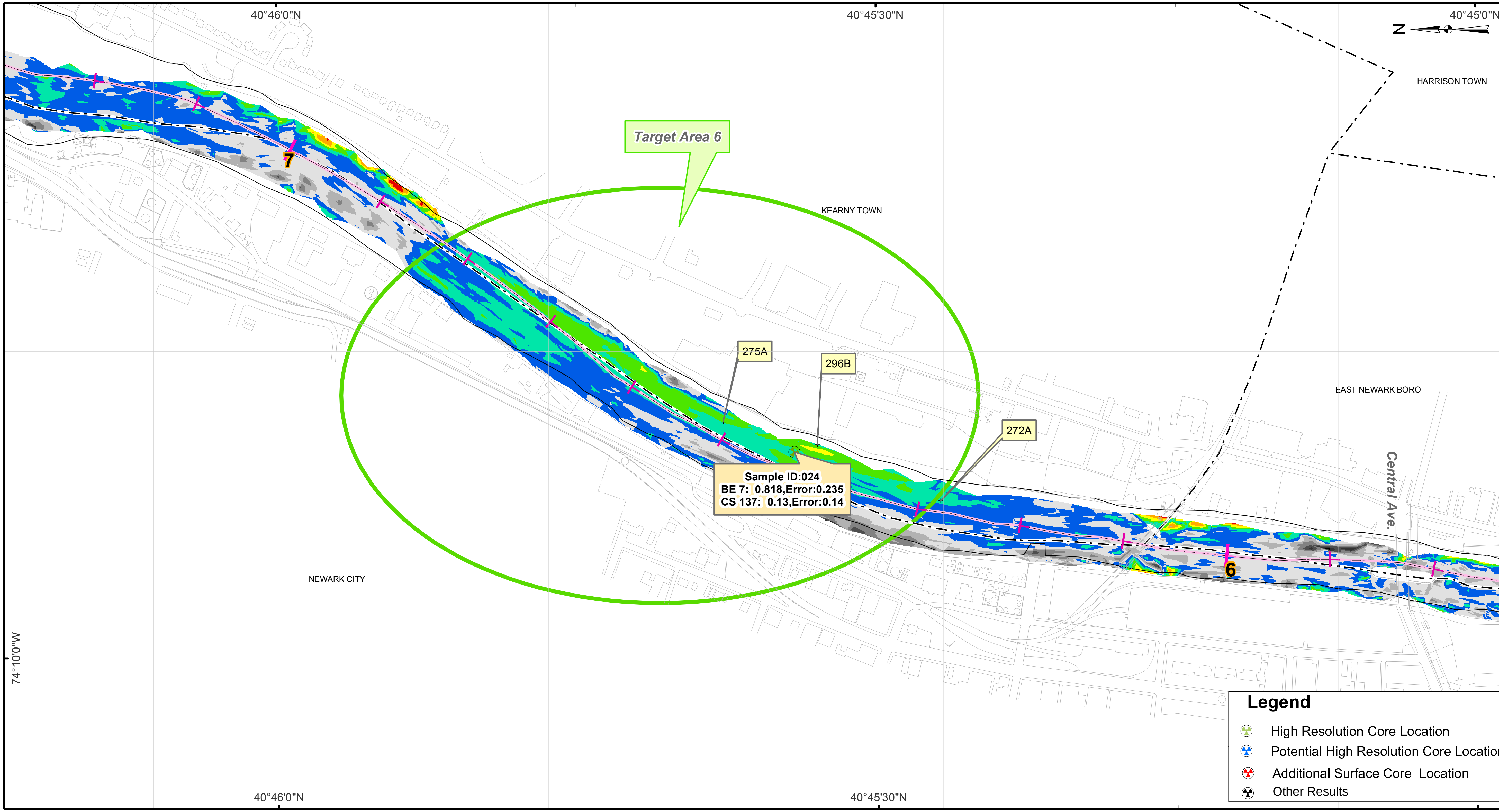

US Army Corps of Engineers

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Lower Passaic River Restoration Project
New Jersey

Sedimentation Rate (1989-2004)

Legend

Sedimentation Rate
Inches per Year

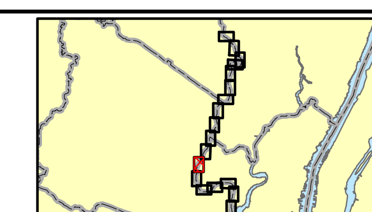
< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

+ BBL Data
River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '



Mile 6 to 7

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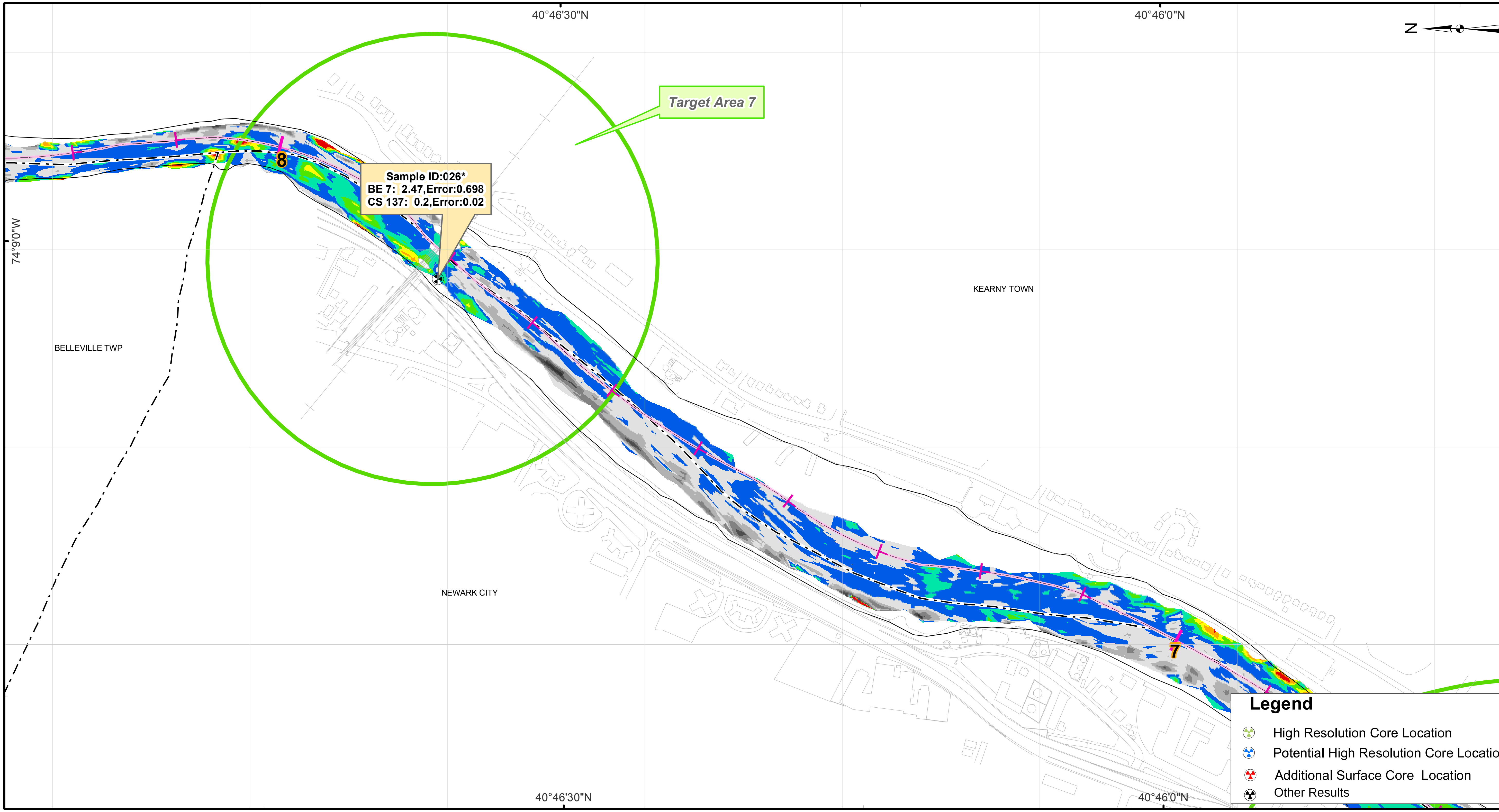

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Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004)

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

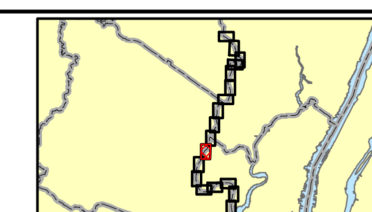
+ BBL Data

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '



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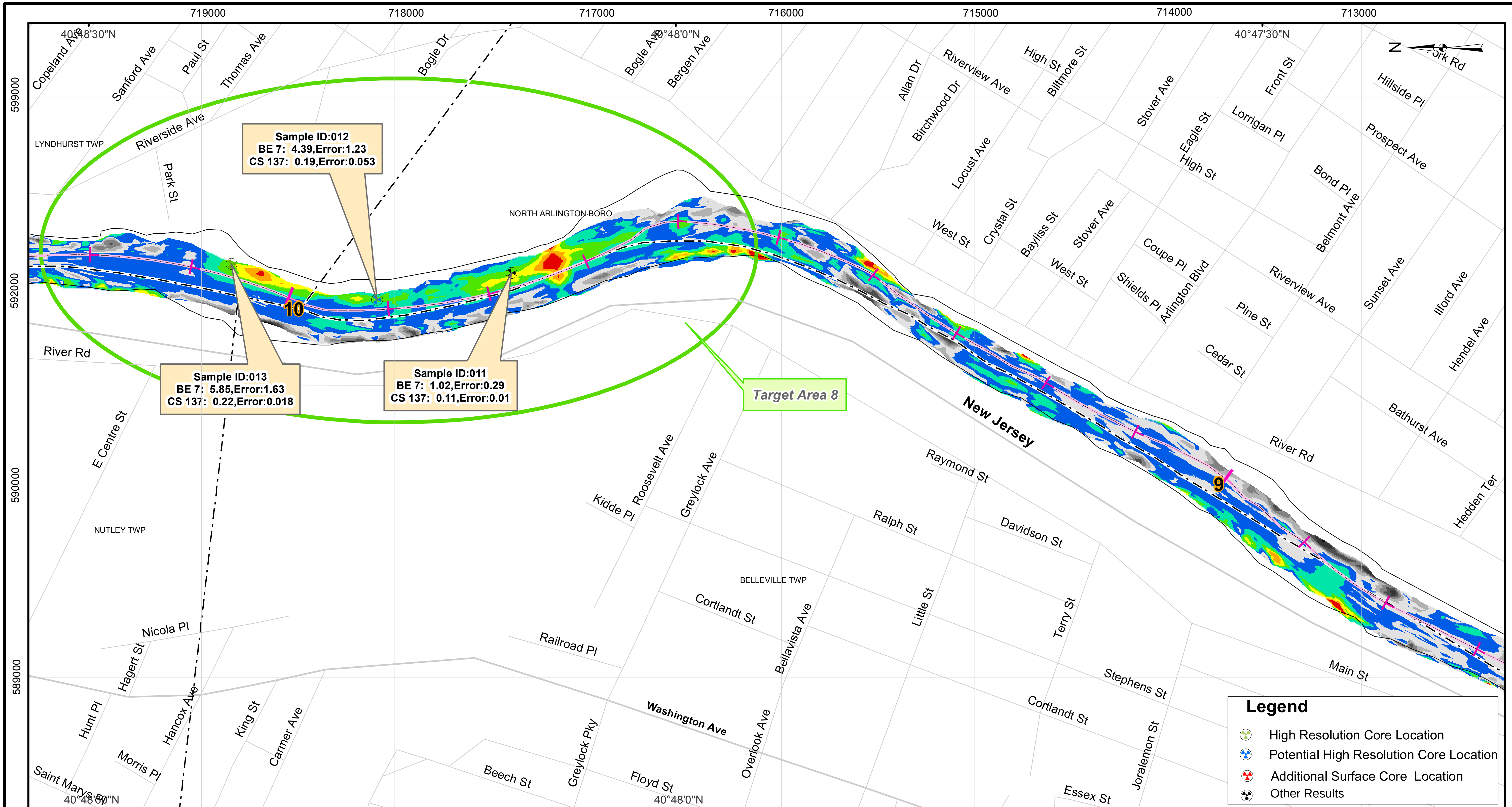

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Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate
(1989-2004)

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

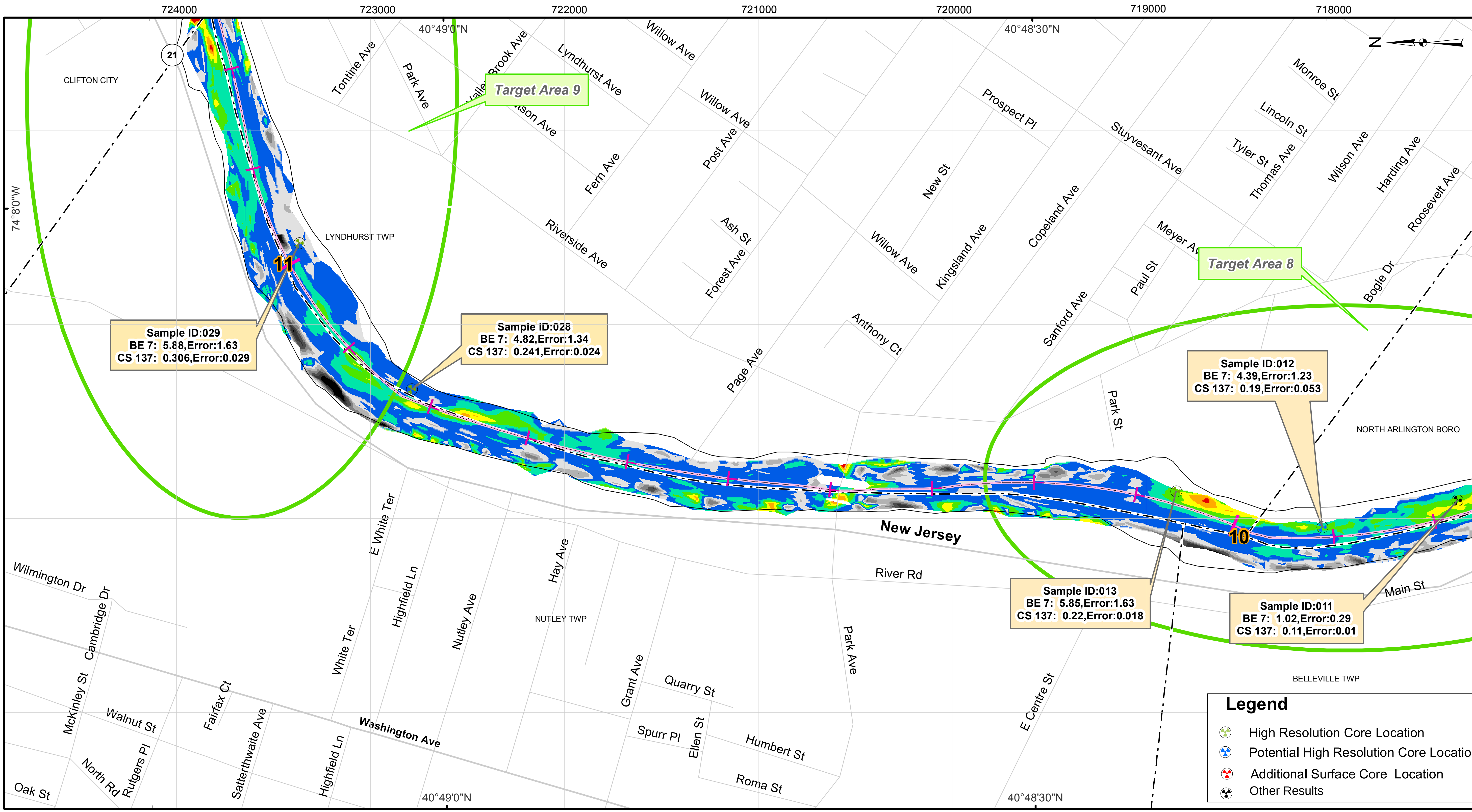
+ BBL Data
River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '

Mile 9 to 10



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Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004)

Legend

Sedimentation Rate
Inches per Year

< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

+ BBL Data

River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '

Mile 10 to 11

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Lower Passaic River
Restoration Project
New Jersey

Sedimentation Rate (1989-2004)

Legend

Sedimentation Rate
Inches per Year

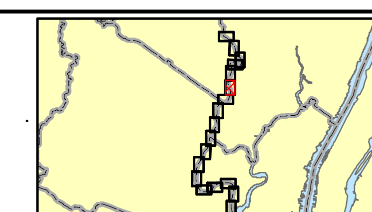
< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

+ BBL Data
River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '



Mile 12 to 13

US Army Corps of Engineers

MALCOLM PIRNIE

Lower Passaic River Restoration Project
New Jersey

Sedimentation Rate (1989-2004)

Legend

Sedimentation Rate
Inches per Year

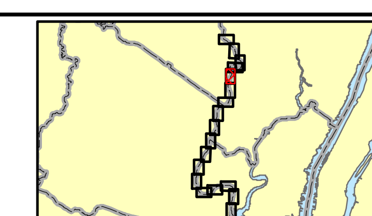
< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

+ BBL Data
River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '



Mile 13 to 14

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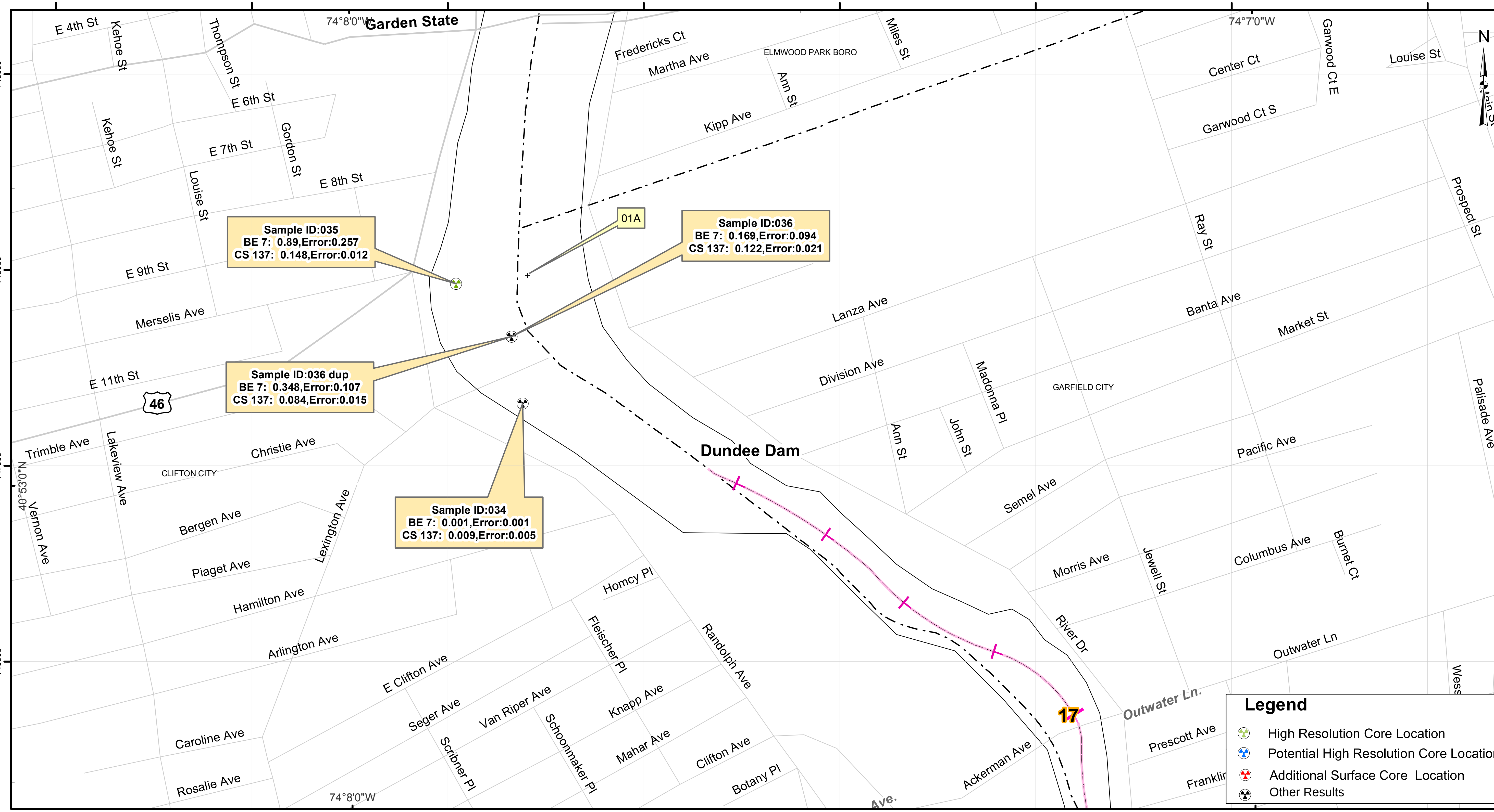


Lower Passaic River Restoration Project New Jersey

Sedimentation Rate (1989-2004)

US Army Corps of Engineers

MALCOLM PIRNIE

Legend

Sedimentation Rate
Inches per Year

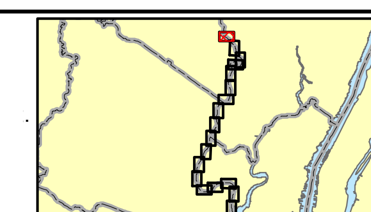
< -5	0 to 1
-5 to -4	1 to 2
-4 to -3	2 to 3
-3 to -2	3 to 4
-2 to -1	4 to 5
-1 to 0	> 5

+ BBL Data
River Mile Post

Coordinate System: State Plane New Jersey
Datum: NAD 83
Units: Feet

0 250 500 1,000

1 " equals 500 '



Mile 17 to Dundee Dam

Map Document: (S:\Projects\PASSAIC\MapDocuments\Proposed Sediments\Coring_Field_Work\Individual_Maps\17_Landscape_Maps.mxd)
11/30/2005 -- 9:00:58 AM

Attachment 5: Communication with Battelle on PREmis Coordinates

Email sent to Len Warner (Malcolm Pirnie, Inc.) from Tom Gulbransen (Battelle) on November 11, 2005 providing the correct coordinates for the PREmis database and a statement from Battelle explaining the coordinate discrepancy.

From: Gulbransen, Tom [mailto:gulbran@BATTELLE.ORG]
Sent: Friday, November 11, 2005 5:59 PM
To: Warner, Len
Cc: Fidler, Bruce; Barrows, Elisabeth S; Morse, Ned (Charles E)
Subject: FW: Passaic River Historical DB Coordinates

Attachment: NYNJ Historical Data Coordinates Revision – September 2005

In the original MP NYNJHist data delivery, samples from "PRSA V.3.0.mdb" had Northing/Easting coordinates in NAD27, whereas the other samples in the database were in NAD83. Latitude/Longitude coordinates from PRSA V.3.0.mdb were incorrect. In September of 2005 Battelle produced a revised table or coordinates, standardizing the datum, merging Latitude/Longitude from reference and actual coordinates, and correcting the Latitude/Longitude coordinates from PRSA V.3.0.mdb.

To produce this revision, Battelle extracted all of the samples and their associated coordinates that were in the MP NYNJHist export, including both target locations from the station table (ref_lat/ref_long) and actual locations from the sample_collection table (latitude/longitude and northing/easting), and produced a new table of coordinates for samples with coordinates standardized to NJ State Plane NAD83 and geographic (lat/lon) NAD83[1]. During this process, the incorrect lat/lon coordinates from PRSA V.3.0.mdb were removed and new lat/lon coordinates were generated from the transformed NJ State Plane NAD83 coordinates.

Six fields are supplied in the new table: X_NJSP83FT, Y_NJSP83FT, XY_NJSP83FT_SOURCE, LON_GCS_NAD83, LAT_GCS_NAD83, LATLON_GCS_NAD83_SOURCE. These fields provide coordinate system/datum-specific coordinates that are consistent for all samples. The X_NJSP83FT field supplies the EASTING (X-coordinate) and the Y_NJSP83FT field supplies the NORTHING (Y-coordinate). NJSP83FT is an abbreviation for New Jersey NAD83 with map units in Feet.

The LON_GCS_NAD83 field supplies the LONGITUDE (X-coordinate) and the LAT_GCS_NAD83 field supplies the LATITUDE (Y-coordinate). GCS_NAD83 is an abbreviation for Geographic Coordinate System NAD83/GRS80 with map units in decimal degrees.

The source of the coordinates – reference or actual – is indicated in the fields ending in _SOURCE (XY_NJSP83FT_SOURCE corresponds to the X_NJSP83FT and Y_NJSP83FT fields/coordinate pairs, LATLON_GCS_NAD83_SOURCE corresponds to the LON_GCS_NAD83 and LAT_GCS_NAD83 fields/coordinate pairs).

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[1] The cartographic purist may make note that NAD (North American Datum) applies to Cartesian coordinate systems such as State Plane, and not to the angle-based geographic coordinate system (GCS). NAD uses an underlying spheroid – in the case of NAD83 the spheroid is GRS80. By geographic (lat/lon) NAD83, we mean GCS based on the GRS80 spheroid and thus compatible with NAD83 without requiring transformation.

The process to generate standardized coordinates included:

1. Generating NJSP83FT coordinates from NJSP27FT coordinates obtained from PRSA V.3.0.mdb.
2. Generating NJSP83FT coordinates for all other samples from GCS coordinates (latitude/longitude).
3. Generating latitude/longitude coordinates from NJSP83FT coordinates that were generated in #1 above.

It should be noted that an assumption was made for lat/lon coordinates in #2 above. The assumption is that the datums for these coordinates are compatible with NAD83 (i.e., either GRS80 or WGS84 datums). The lat/lon coordinates come from a number of sources but it is not normal to leave lat/lon coordinates in an incompatible datum such as Clarke 1866 (the datum used in NAD27).

Attachment 6: HydroQual Water Column Data Compilation

HydroQual Inc. memorandum dated December 8, 2005 presenting water column data available from the CARP and PREmis databases for select chemicals.

Environmental
Engineers & Scientists

December 8, 2005

Bruce Fidler, P.E.
Senior Associate
Malcolm Pirnie, Inc.
17-17 Route 208 North
Fair Lawn, NJ 07410

MPIN0021

Dear Bruce:

Please find enclosed HydroQual's final product relative to the Preliminary Geochemical Evaluation-Scope of Work of May 16, 2005 (WAD 5, WO 7.3). As you will notice, and as explained below, some of the deliverables are missing, mainly as a result of missing data or information.

Under deliverable number 5 of the May 2005 Scope of Work, HydroQual was contracted to generate plots that show the ratio of the suspended-phase (mg contaminant per kilogram solid) to the surficial sediment concentration (mg contaminant per kilogram solid) versus river mile. In order to generate these plots, concurrent data are required (*i.e.*, surficial sediment samples collected at the same time as the water column samples). In spite of the abundance of sediment data, only few water column measurements were reported in the PREmis and the CARP databases. For example in the case of total DDT, two instances exist where both suspended phase and surficial concentrations were available for the same locations; however, the sampling dates for these samples were not coincident. The same scenario is true for the other contaminants examined. In the absence of concurrent measurements, the calculated ratios would be difficult to interpret, and thus plots for deliverable number 5 are not provided in the final product. However, we have generated plots showing discrete suspended phase and surficial sediment contaminant data.

Under deliverable number 3 of the May 2005 Scope of Work, HydroQual was contracted to generate plots that show the ratio of the dissolved-phase (mg contaminant per liter) to the total concentration (mg contaminant per liter) versus river mile. In the CARP database, the New Jersey data set (e.g., NJSIT) contains dissolved-phase and suspended-phase data for most toxic chemicals. However, the suspended phase occasionally was not reported while for other chemicals (e.g., Dioxin and Furans) only the suspended phase was reported. Meanwhile, the New York data set (e.g., Simon Litten) of the CARP database contains total, dissolved, and suspended phase information for some chemicals and some time periods. Since only partial information was available, the total-phase was either not reported or could not be reconstructed with the available data.

To create the required plots, total-phase for each contaminant from the New Jersey database was calculated from the available suspended-phase and dissolved-phase data while the total-phase from the New York database was used as reported or re-constructed when possible. Therefore, the

HydroQual, Inc.

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"missing" total-phase points that appear between deliverable number 3 and 4 represent cases where the total-phase was either not reported or could not be reconstructed because either the dissolved or the suspended phase data were not provided.

Under deliverable number 4 of the May 2005 Scope of Work, HydroQual was contracted to generate plots that show the ratio of the dissolved-phase (mg contaminant per liter) to the suspended-phase (mg contaminant per kilogram solid) versus river mile, including the corresponding salinity information. There were no concurrent water column concentration data and salinity data reported in the CARP or PREmis databases.

In addition, the PREmis database provided insufficient description of the historical water column data. Contaminants were reported as surface water composite, surface water particulate or surface water. In spite of a joint HydroQual-Malcolm Pirnie effort, it was not possible to define the descriptions in terms of total, dissolved and particulate components. As a consequence, deliverables 2, 3, 4 and 5 were not generated for the PREmis data. Instead, HydroQual has generated for each contaminant a plot showing the PREmis water column data "as reported" and the CARP data with different sampling years versus river mile.

If you have any question, please call me at 201-529-5151.

Very truly yours,

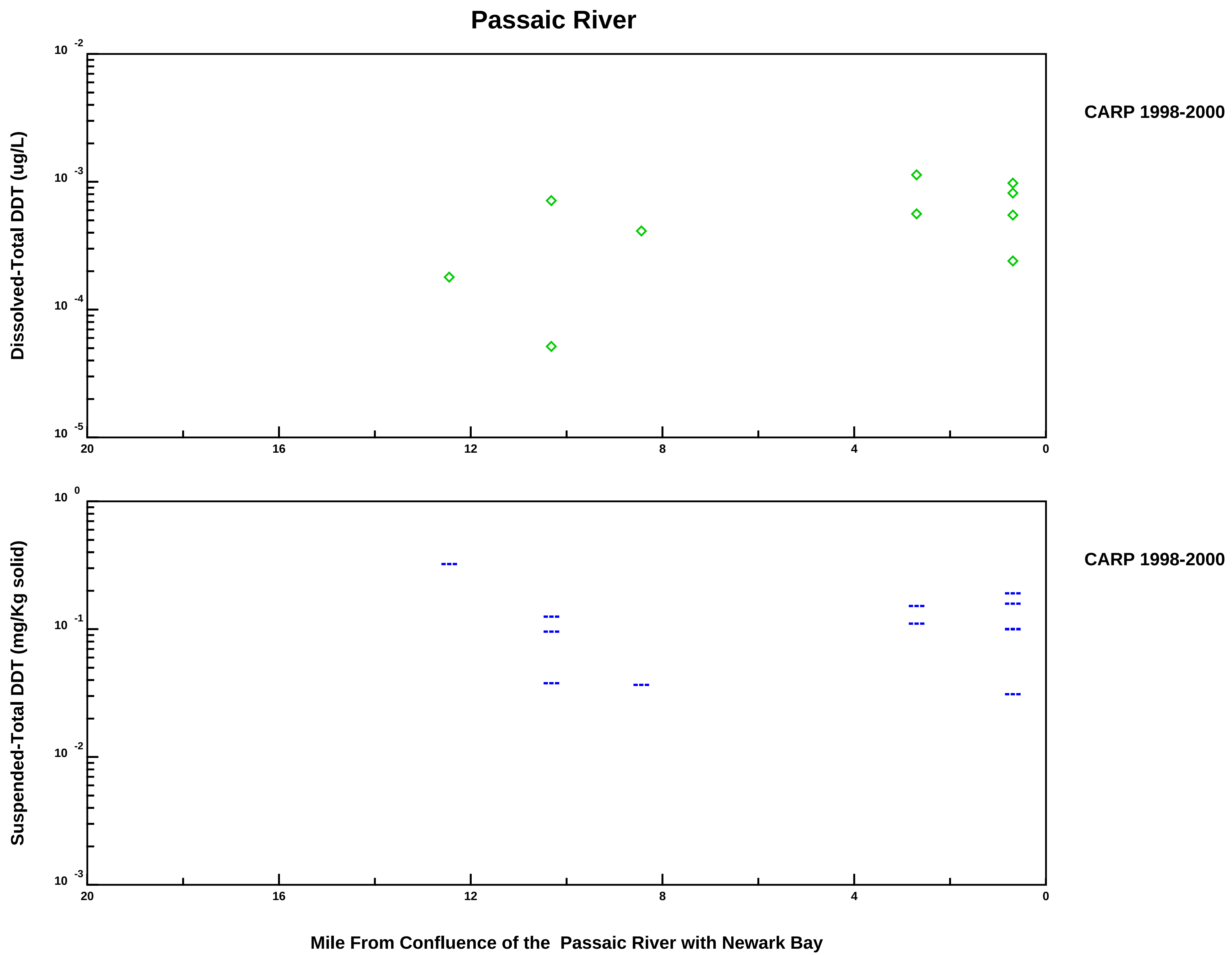
HYDROQUAL, INC.

Paul Anid

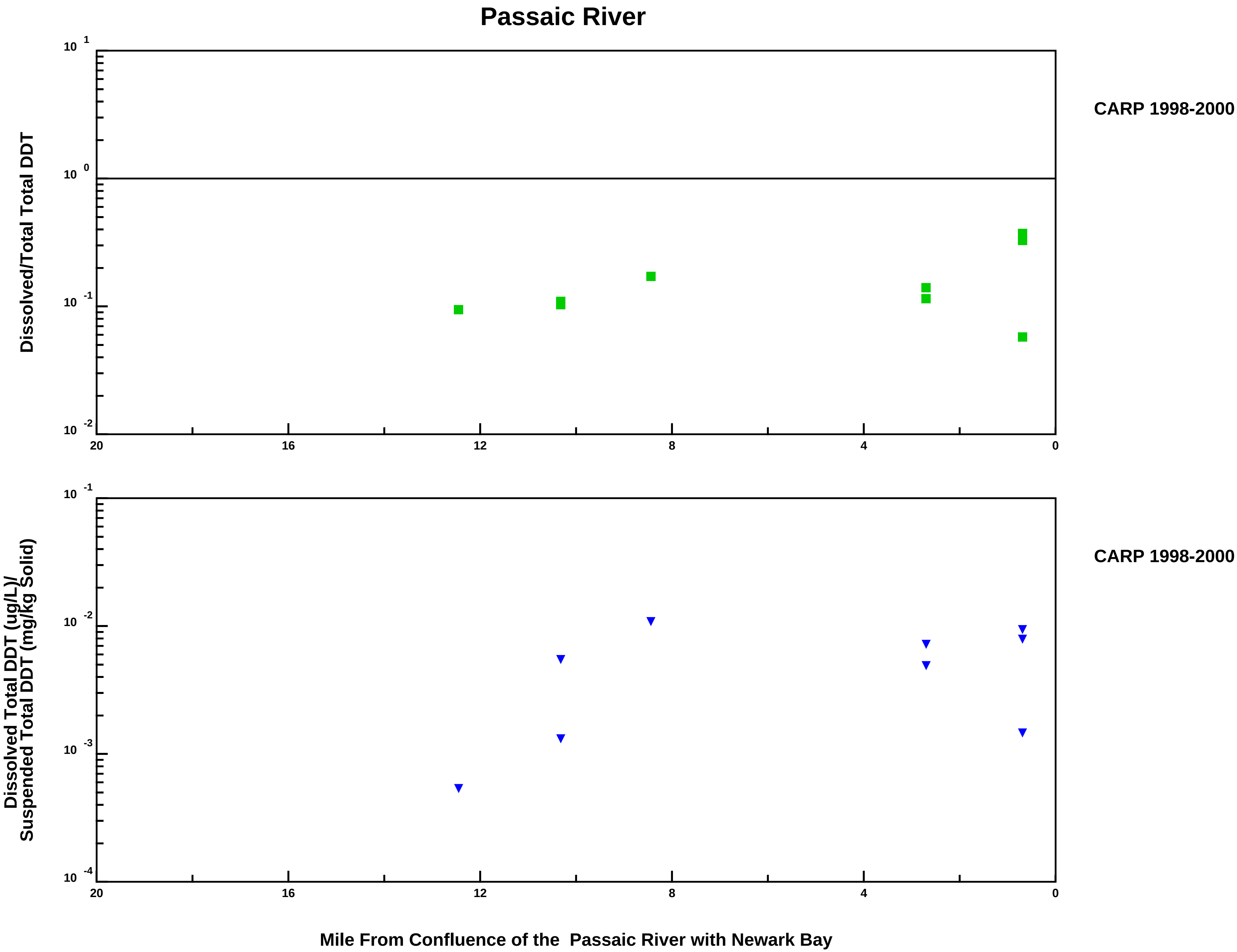
Paul J. Anid, Dr.Sc.
Principal Scientist

PJA/mag
...MPIN0021/FIDLER08DEC05LTR
Cc: Jim Fitzpatrick, HydroQual, Inc.
AmyMarie Accardi-Dey, Malcolm Pirnie

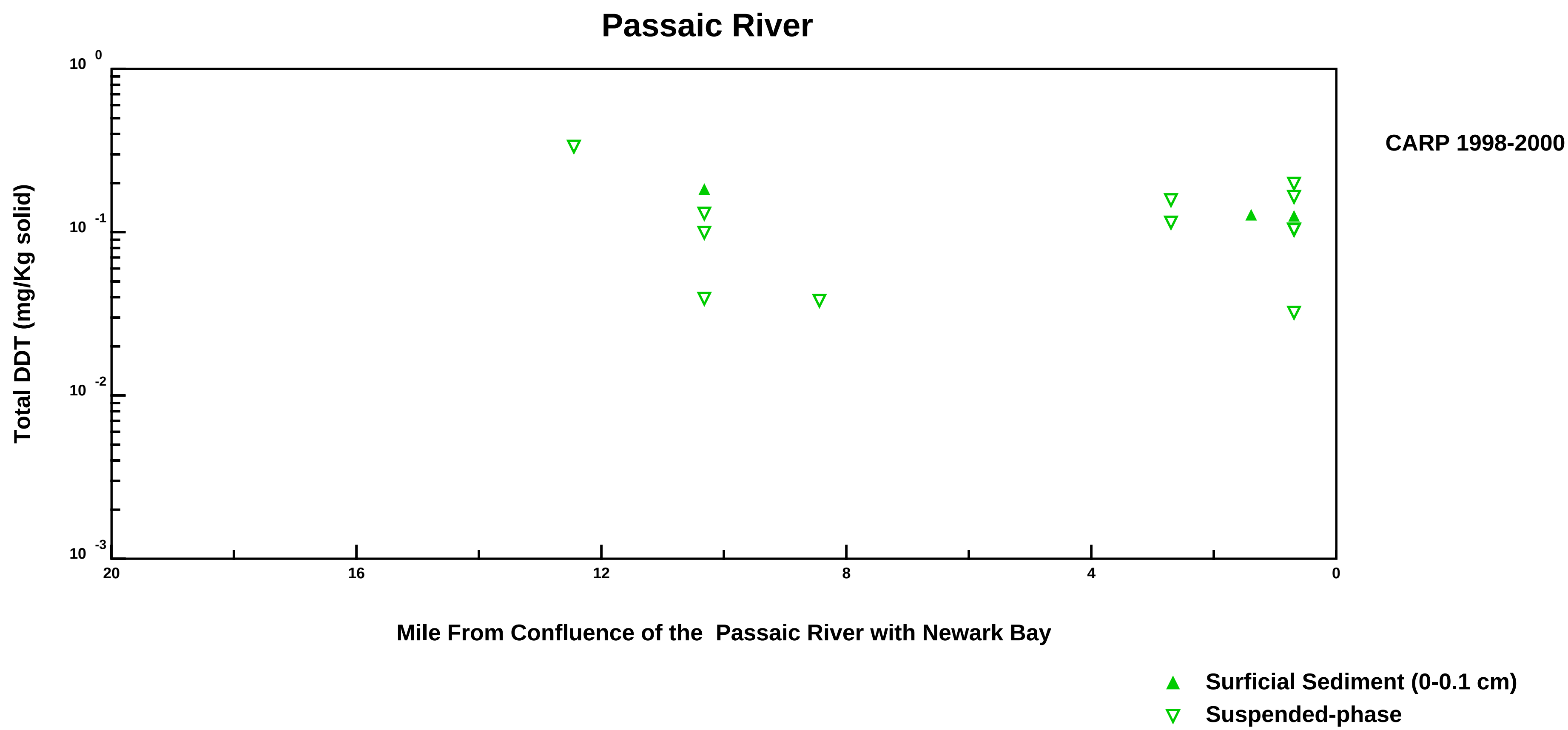
CARP PLOTS
(CARP_Passaic.pdf)



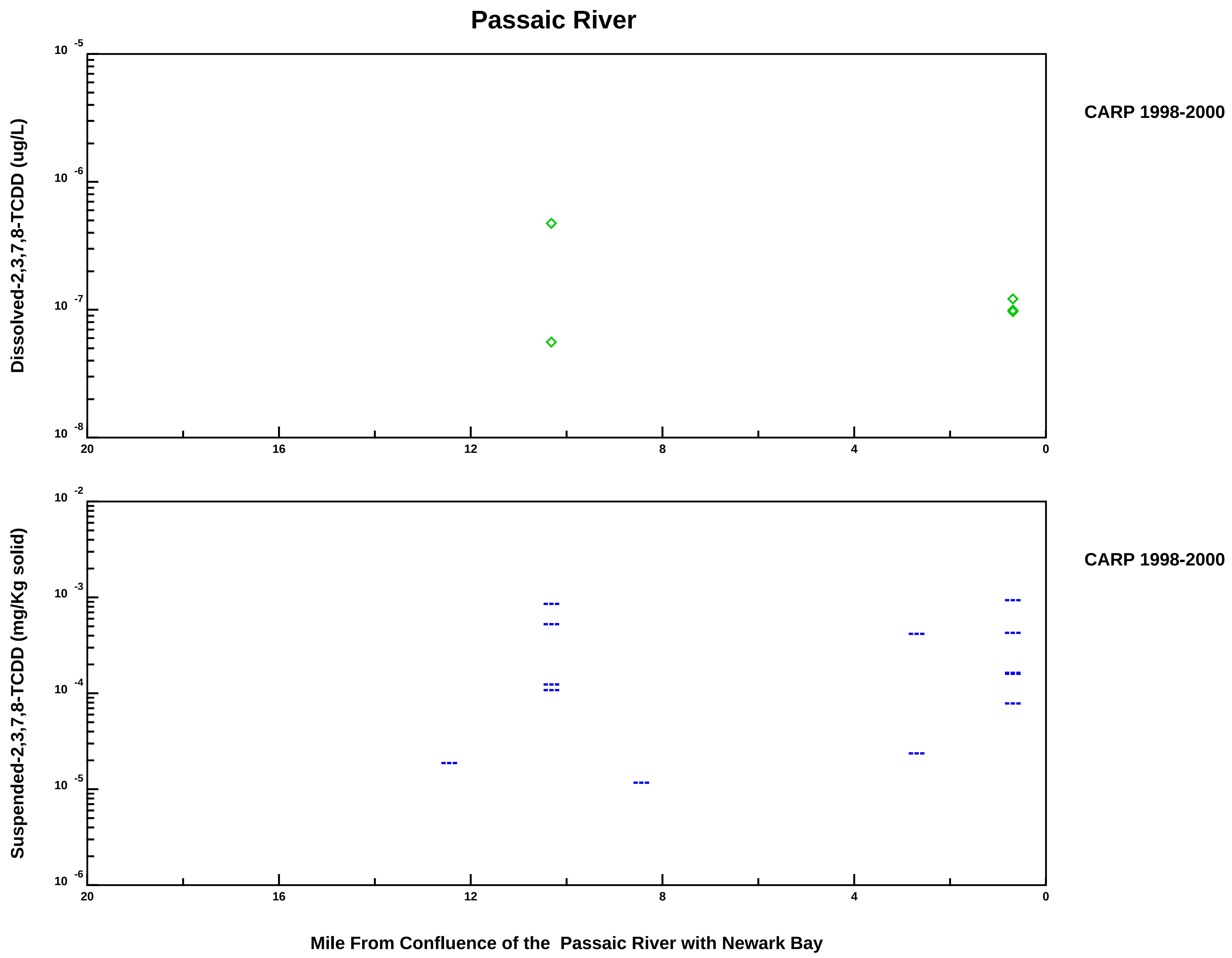
Passaic River
CARP 1998-2000
Dissolved-Total DDT (ug/L)
10 -2
10 -3
10 -4
10 -5
20
16
12
8
4
0
CARP 1998-2000
Suspended-Total DDT (mg/Kg solid)
10 0
10 -1
10 -2
10 -3
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay



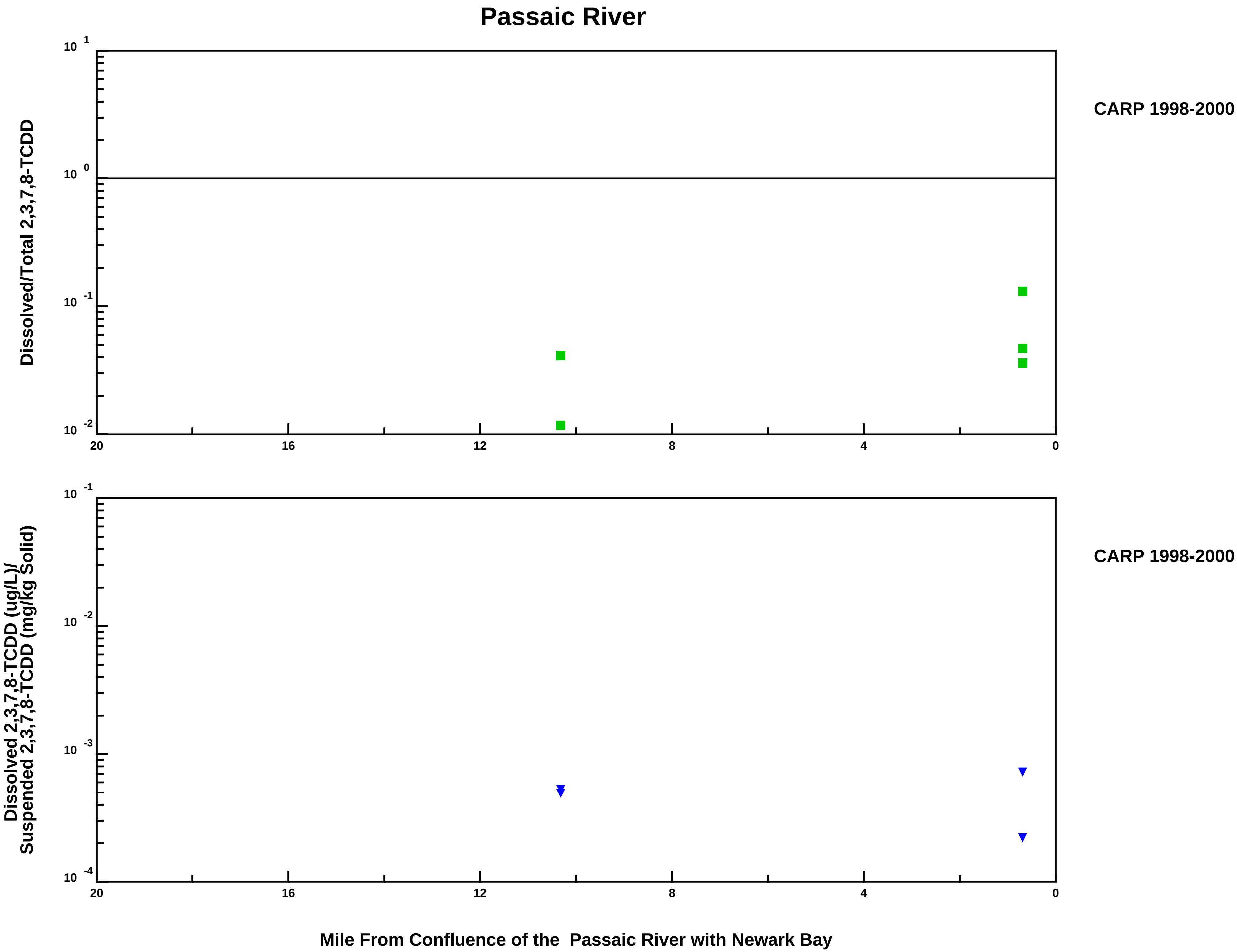
Passaic River
CARP 1998-2000
Dissolved/Total Total DDT
10 1
10 0
10 -1
10 -2
20
16
12
8
4
0
CARP 1998-2000
Dissolved Total DDT (ug/L)/
Suspended Total DDT (mg/kg Solid)
10 -1
10 -2
10 -3
10 -4
Mile From Confluence of the Passaic River with Newark Bay



Passaic River
CARP 1998-2000
Total DDT (mg/Kg solid)
10 0
10 -1
10 -2
10 -3
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
Surficial Sediment (0-0.1 cm)
Suspended-phase

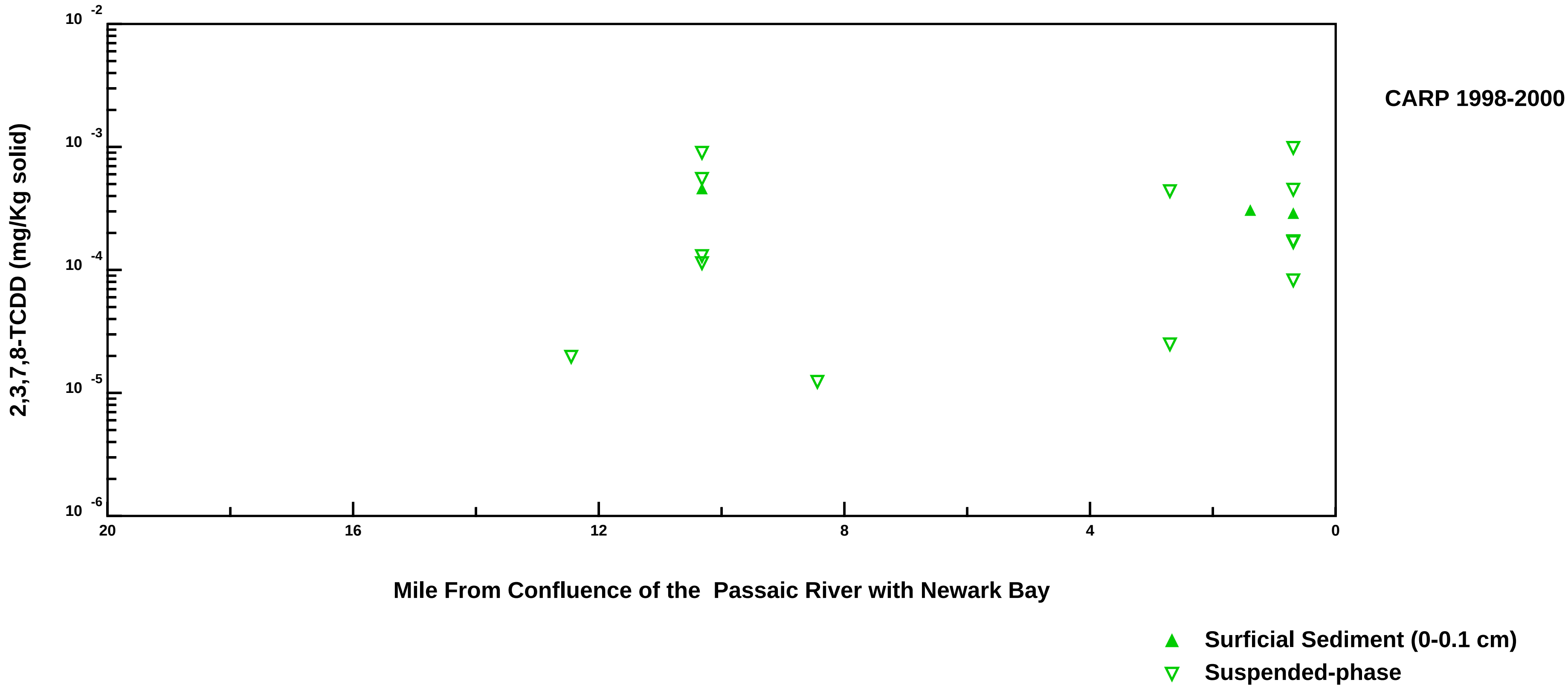


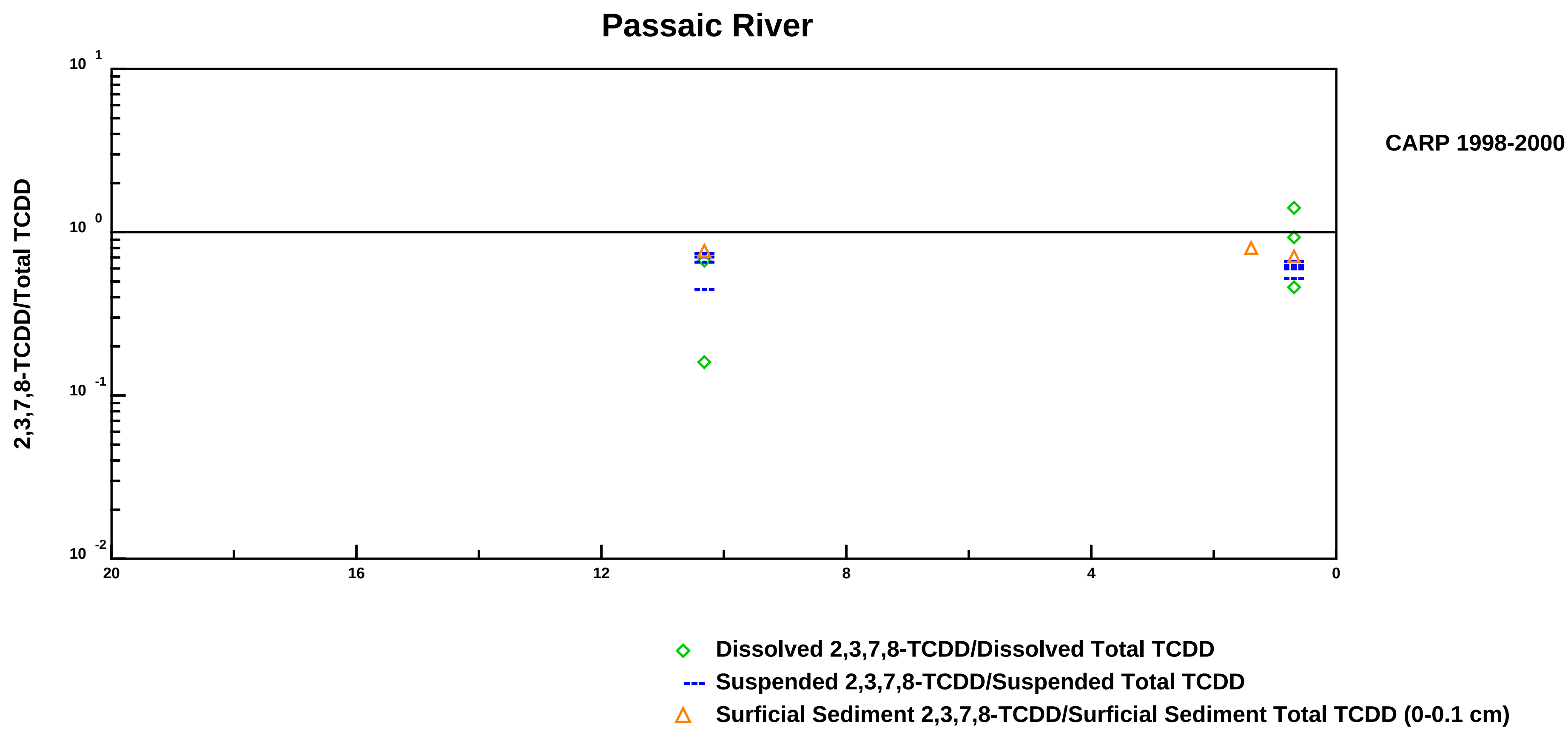
Passaic River
CARP 1998-2000
CARP 1998-2000
Dissolved-2,3,7,8-TCDD (ug/L)
Suspended-2,3,7,8-TCDD (mg/Kg solid)
10 -5
10 -6
10 -7
10 -8
10 -2
10 -3
10 -4
10 -5
10 -6
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay



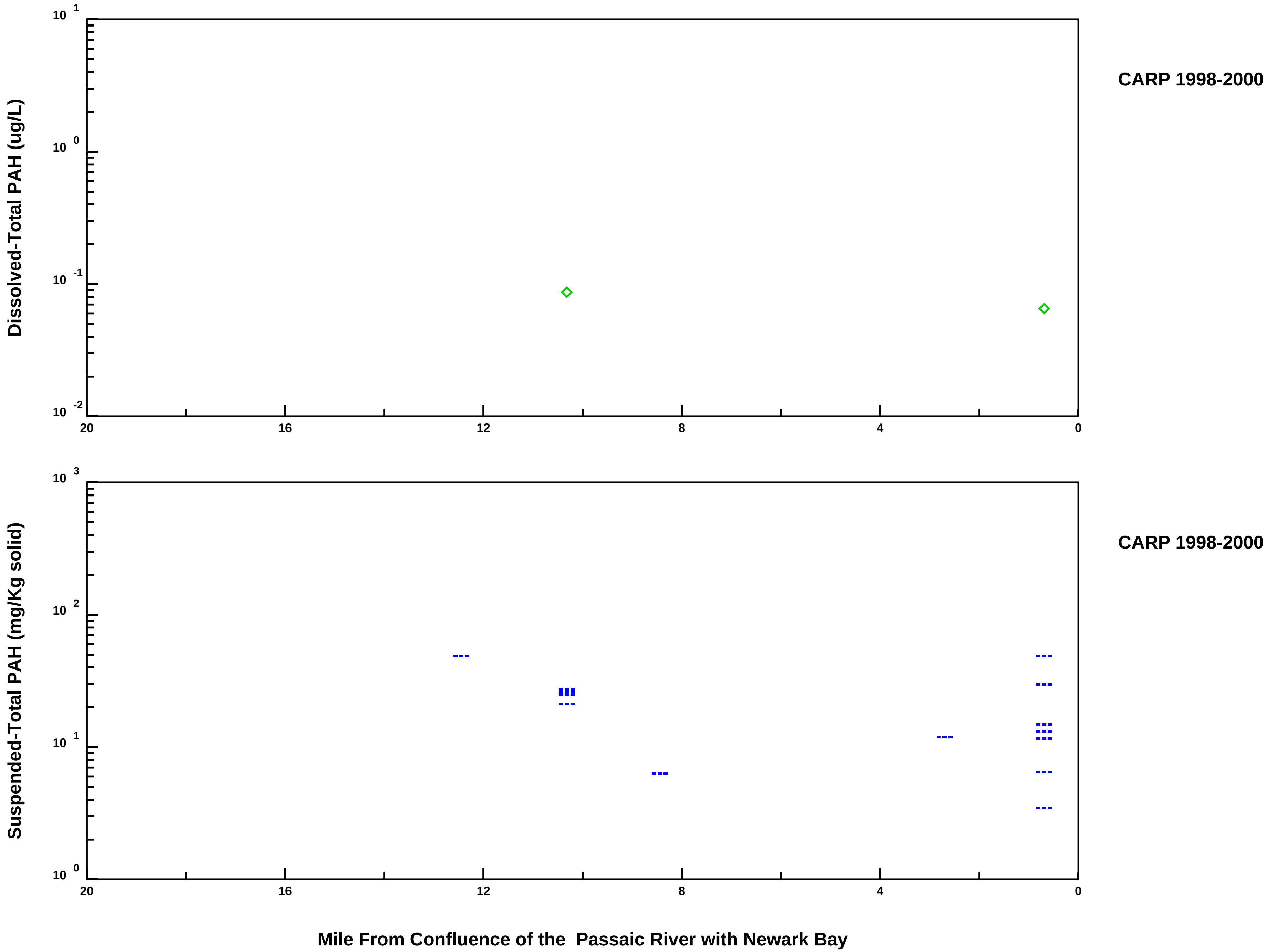
Passaic River
CARP 1998-2000
Dissolved/Total 2,3,7,8-TCDD
10 1
10 0
10 -1
10 -2
20
16
12
8
4
0
CARP 1998-2000
Dissolved 2,3,7,8-TCDD (ug/L)/
Suspended 2,3,7,8-TCDD (mg/kg Solid)
10 -1
10 -2
10 -3
10 -4
Mile From Confluence of the Passaic River with Newark Bay

Passaic River

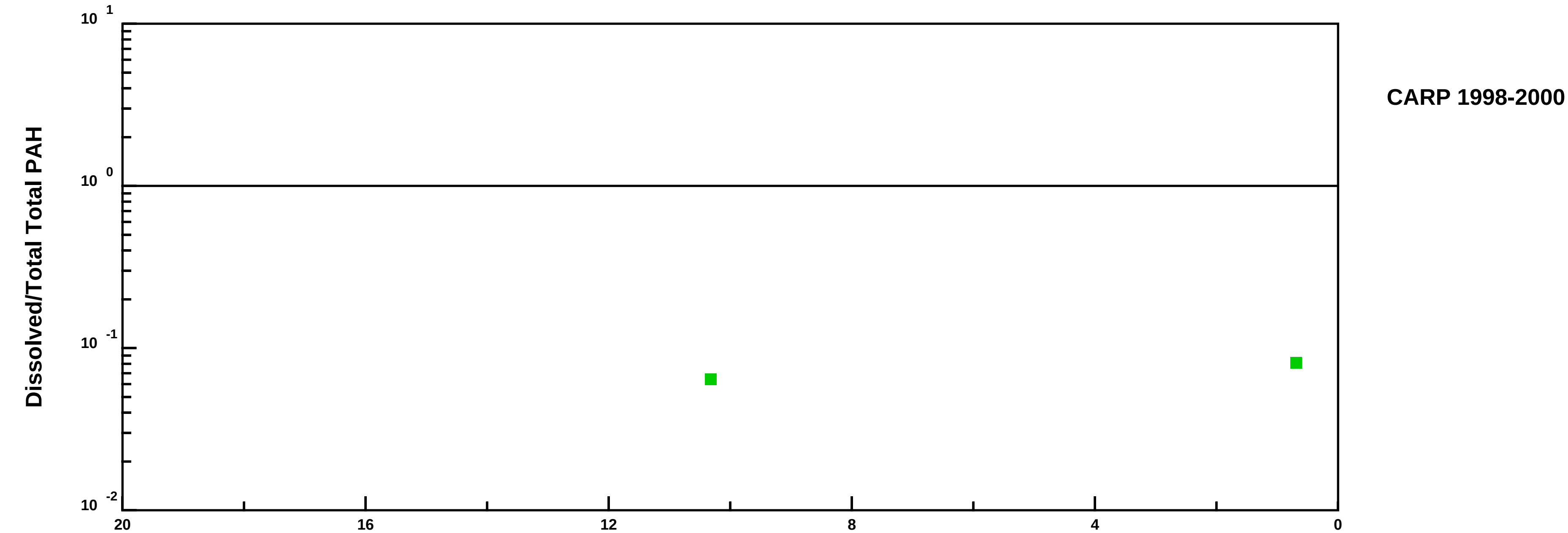


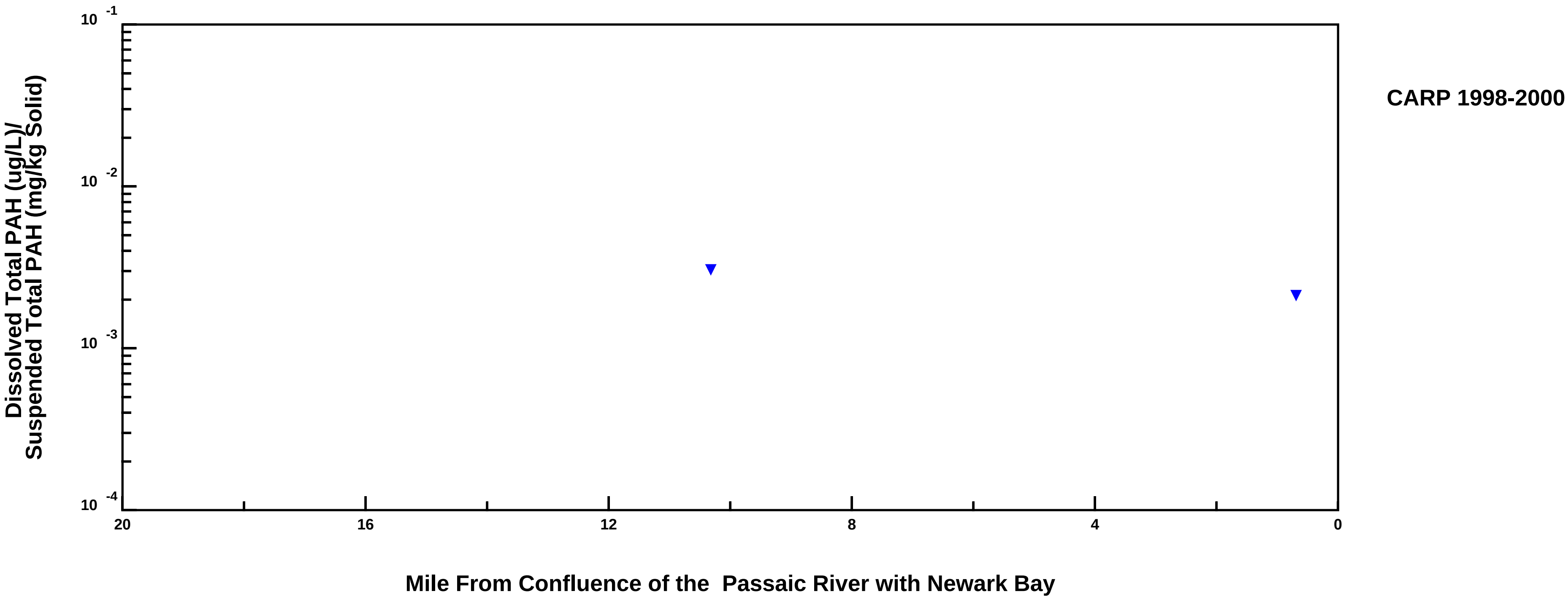

Passaic River
CARP 1998-2000
2,3,7,8-TCDD/Total TCDD
10 1
10 0
10 -1
10 -2
20
16
12
8
4
0
Dissolved 2,3,7,8-TCDD/Dissolved Total TCDD
Suspended 2,3,7,8-TCDD/Suspended Total TCDD
Surficial Sediment 2,3,7,8-TCDD/Surficial Sediment Total TCDD (0-0.1 cm)

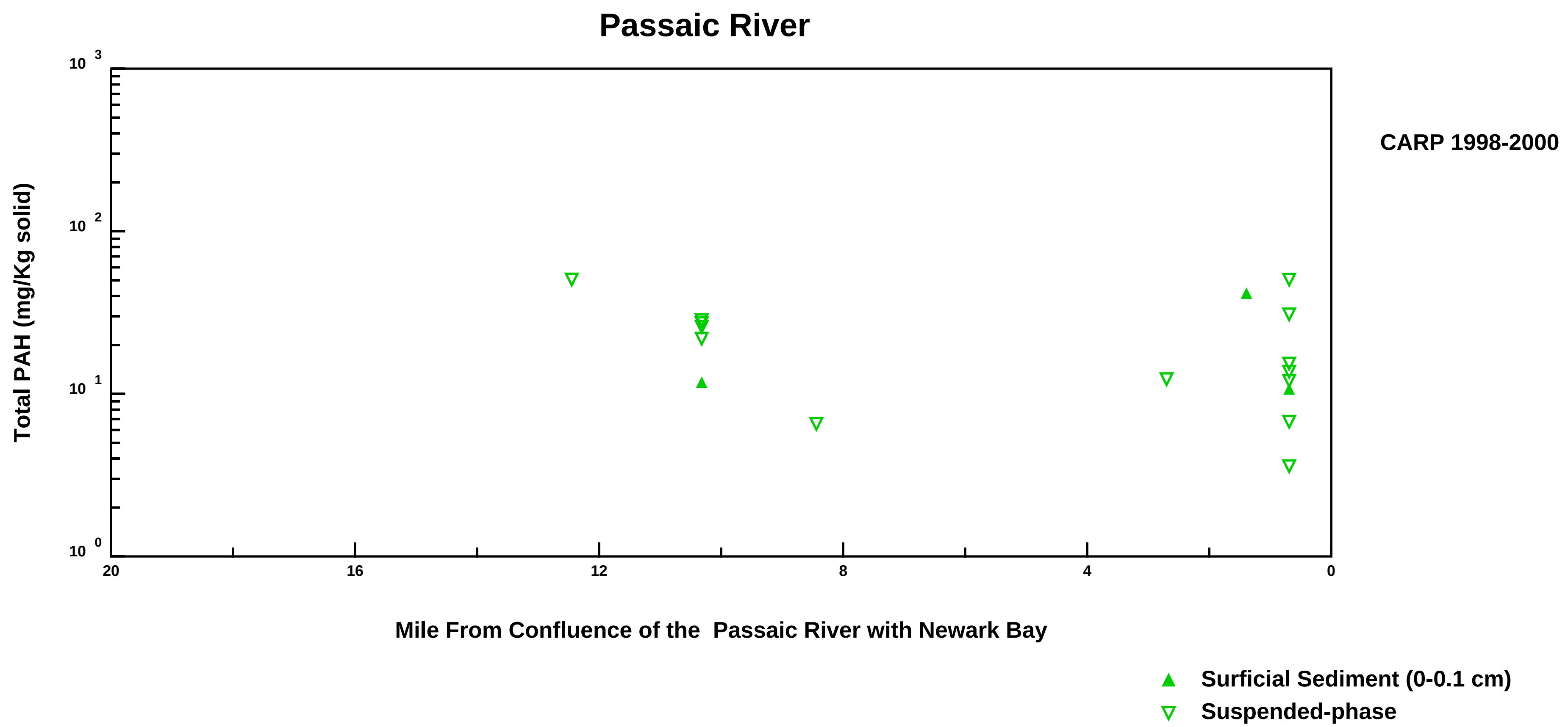
Passaic River



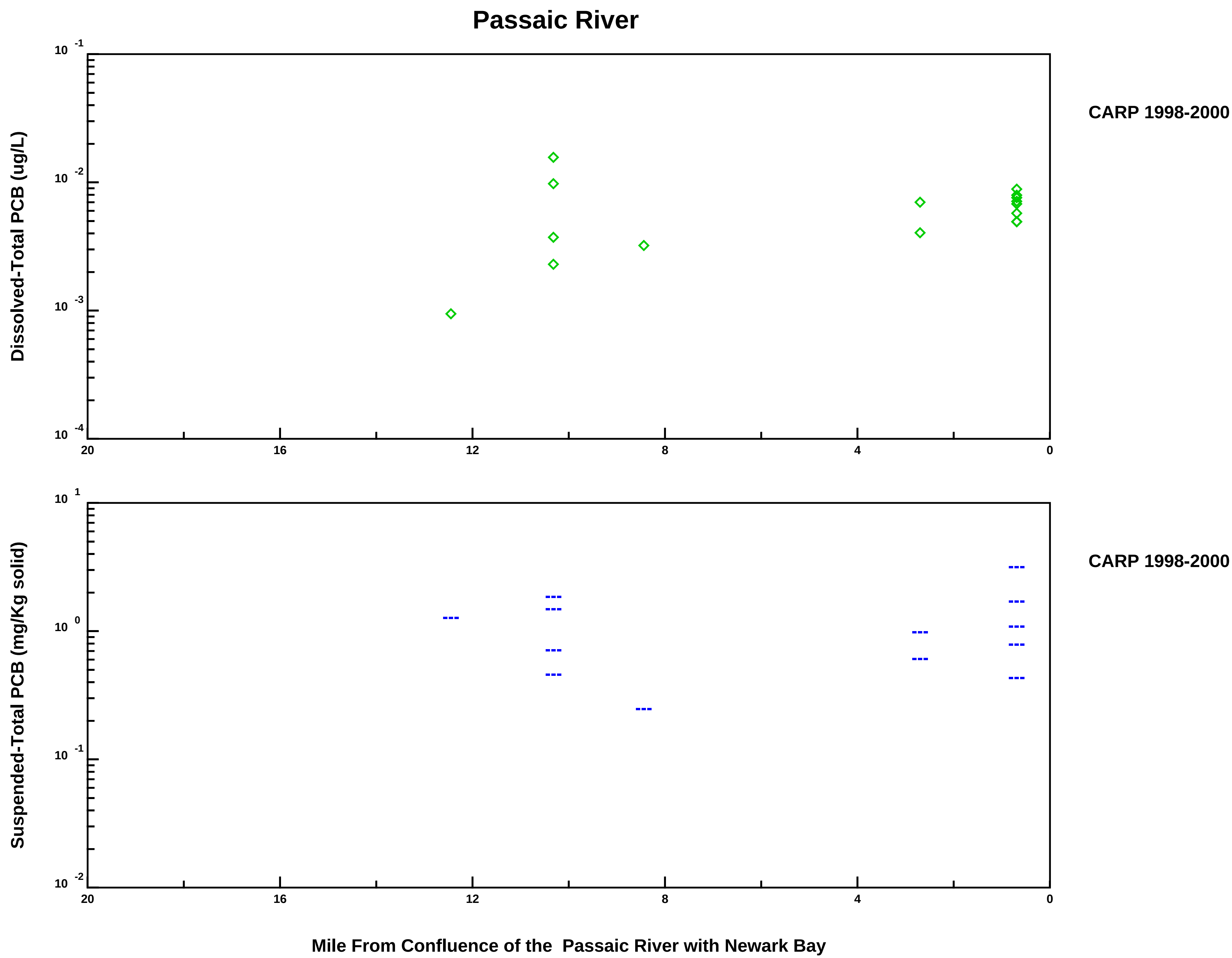
Passaic River



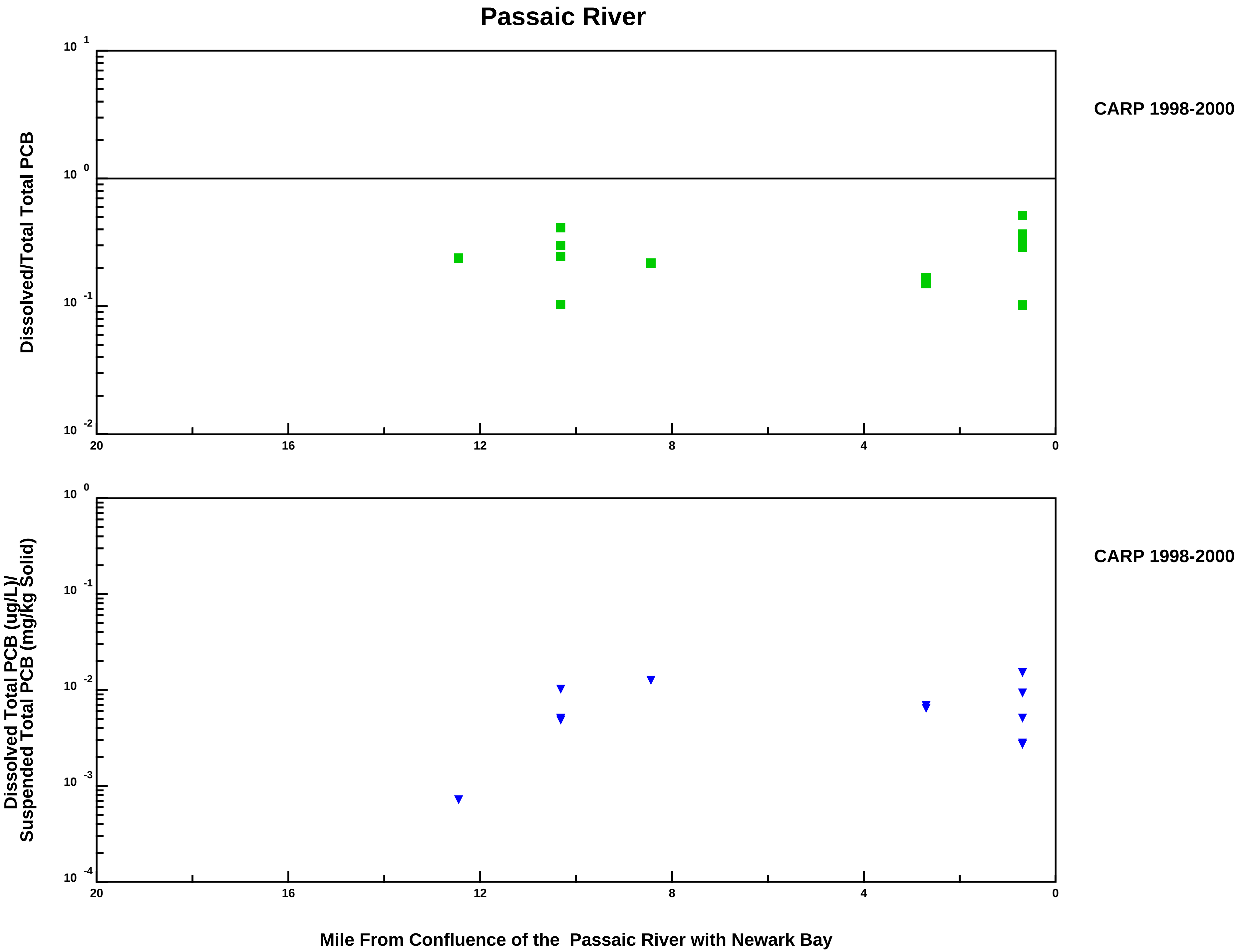


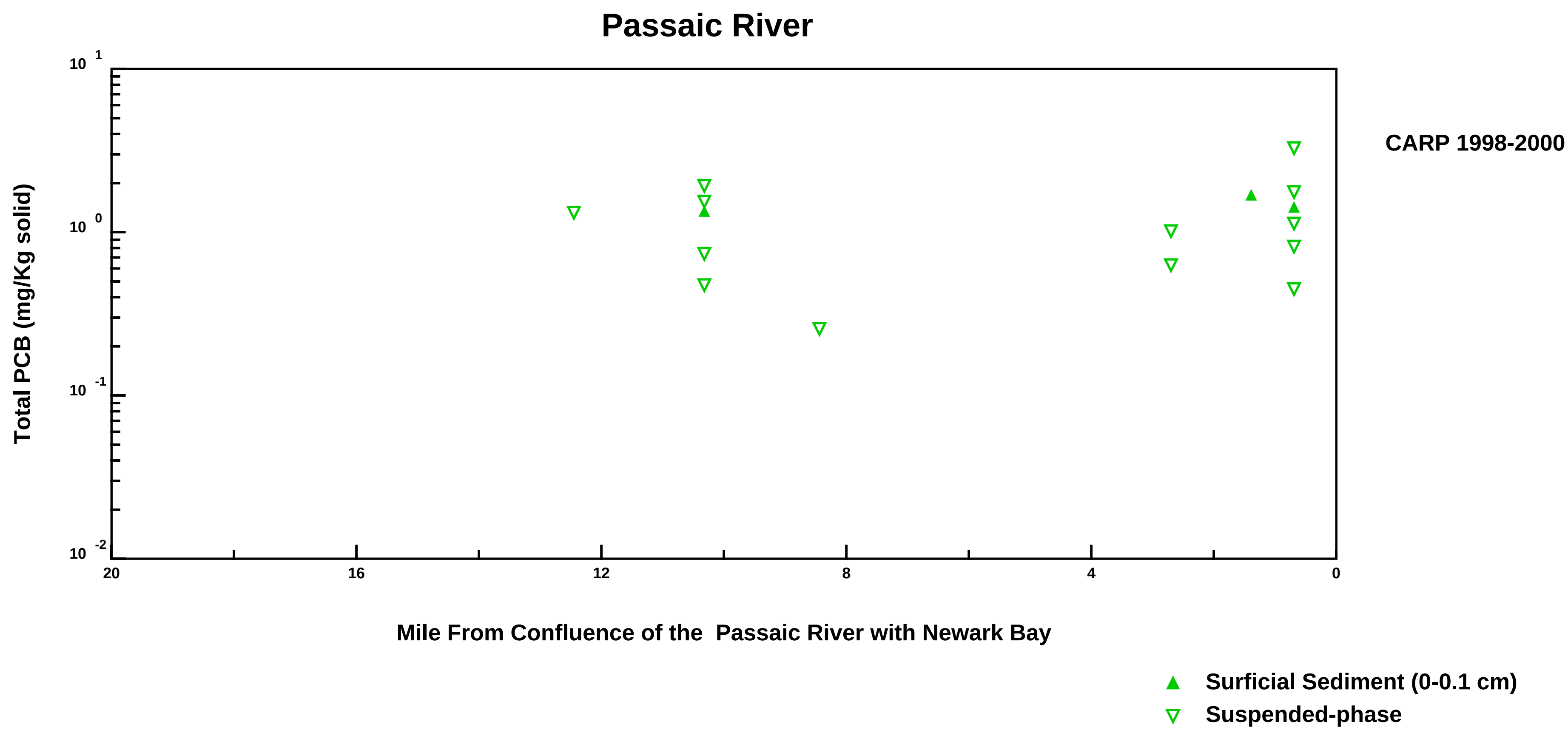


Passaic River
CARP 1998-2000
Total PAH (mg/Kg solid)
10 0
10 1
10 2
10 3
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
Surficial Sediment (0-0.1 cm)
Suspended-phase

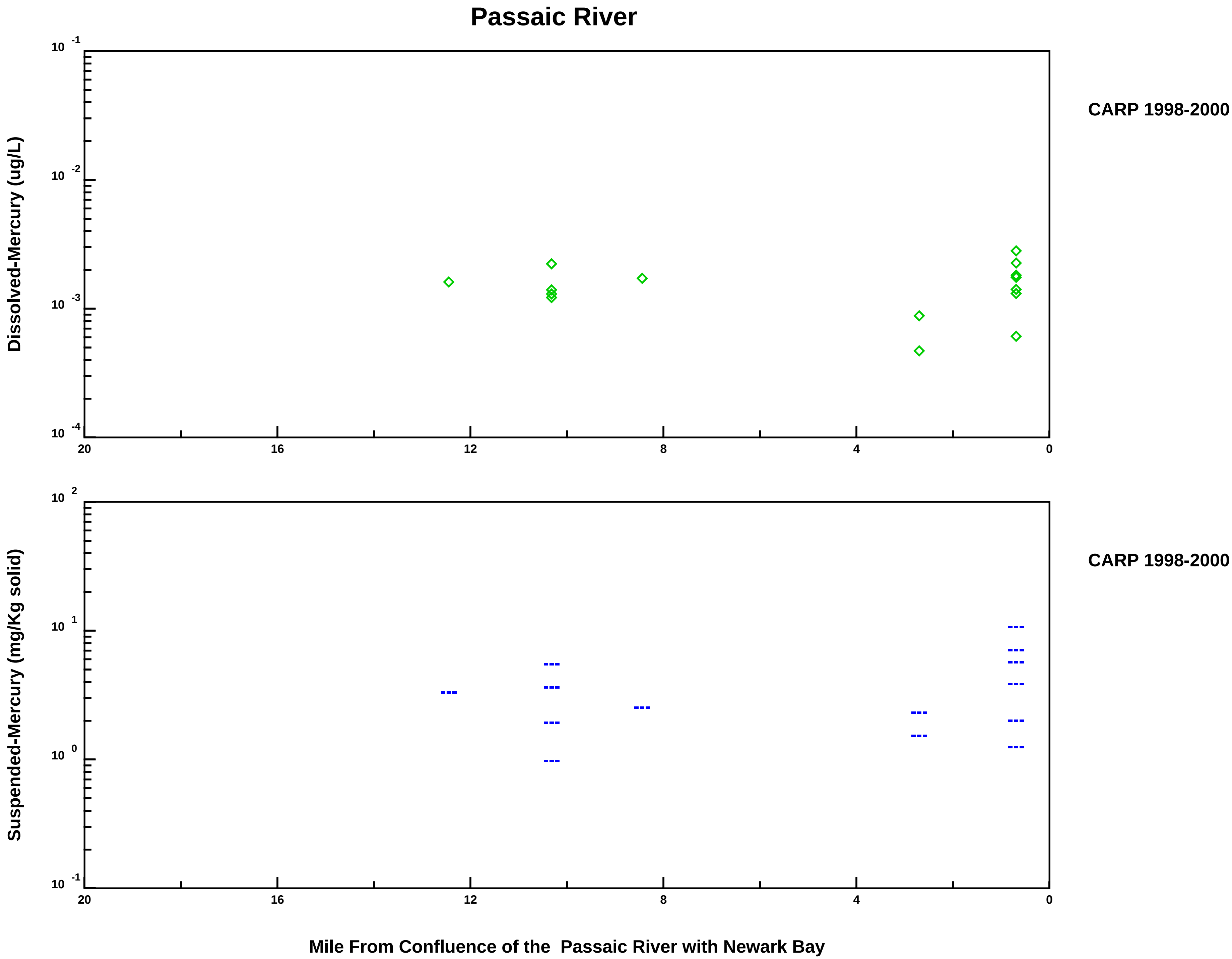


Passaic River
CARP 1998-2000
Dissolved-Total PCB (ug/L)
10 -1
10 -2
10 -3
10 -4
20
16
12
8
4
0
CARP 1998-2000
Suspended-Total PCB (mg/Kg solid)
10 1
10 0
10 -1
10 -2
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay


Passaic River
CARP 1998-2000
Dissolved/Total Total PCB
10 1
10 0
10 -1
10 -2
20
16
12
8
4
0
CARP 1998-2000
Dissolved Total PCB (ug/L)/
Suspended Total PCB (mg/kg Solid)
10 0
10 -1
10 -2
10 -3
10 -4
Mile From Confluence of the Passaic River with Newark Bay

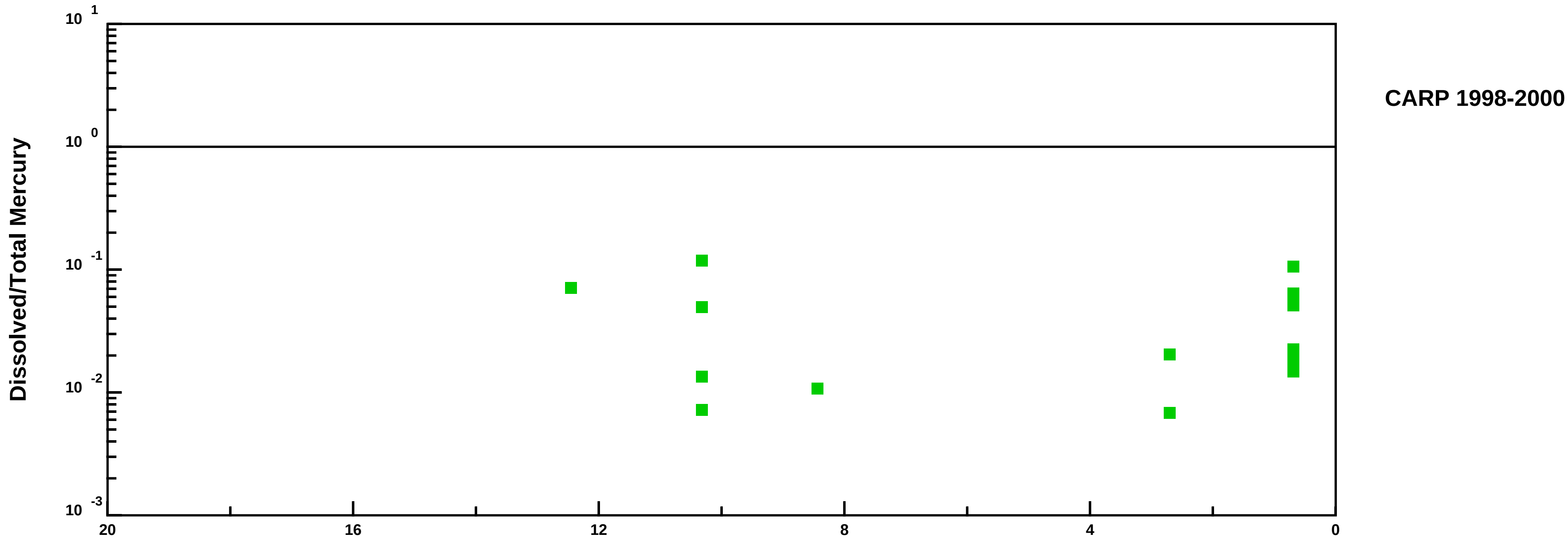


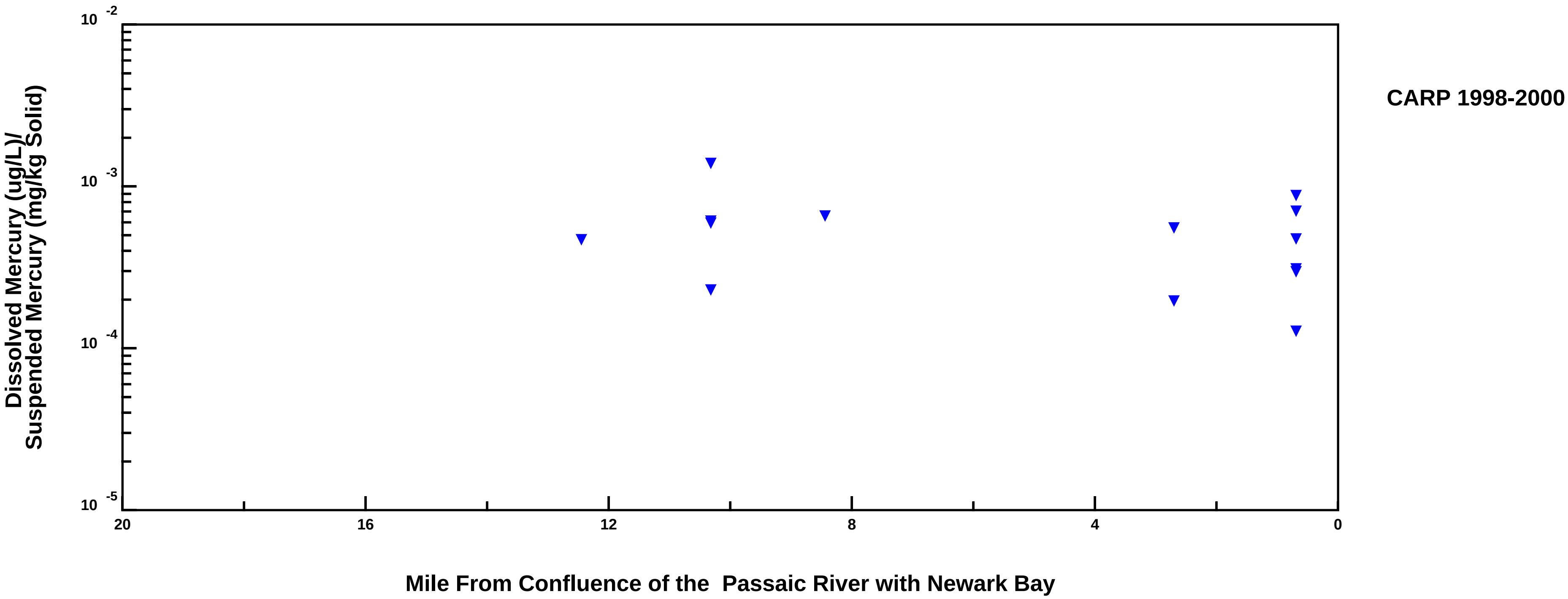
Passaic River
CARP 1998-2000
Total PCB (mg/Kg solid)
10 1
10 0
10 -1
10 -2
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
Surficial Sediment (0-0.1 cm)
Suspended-phase

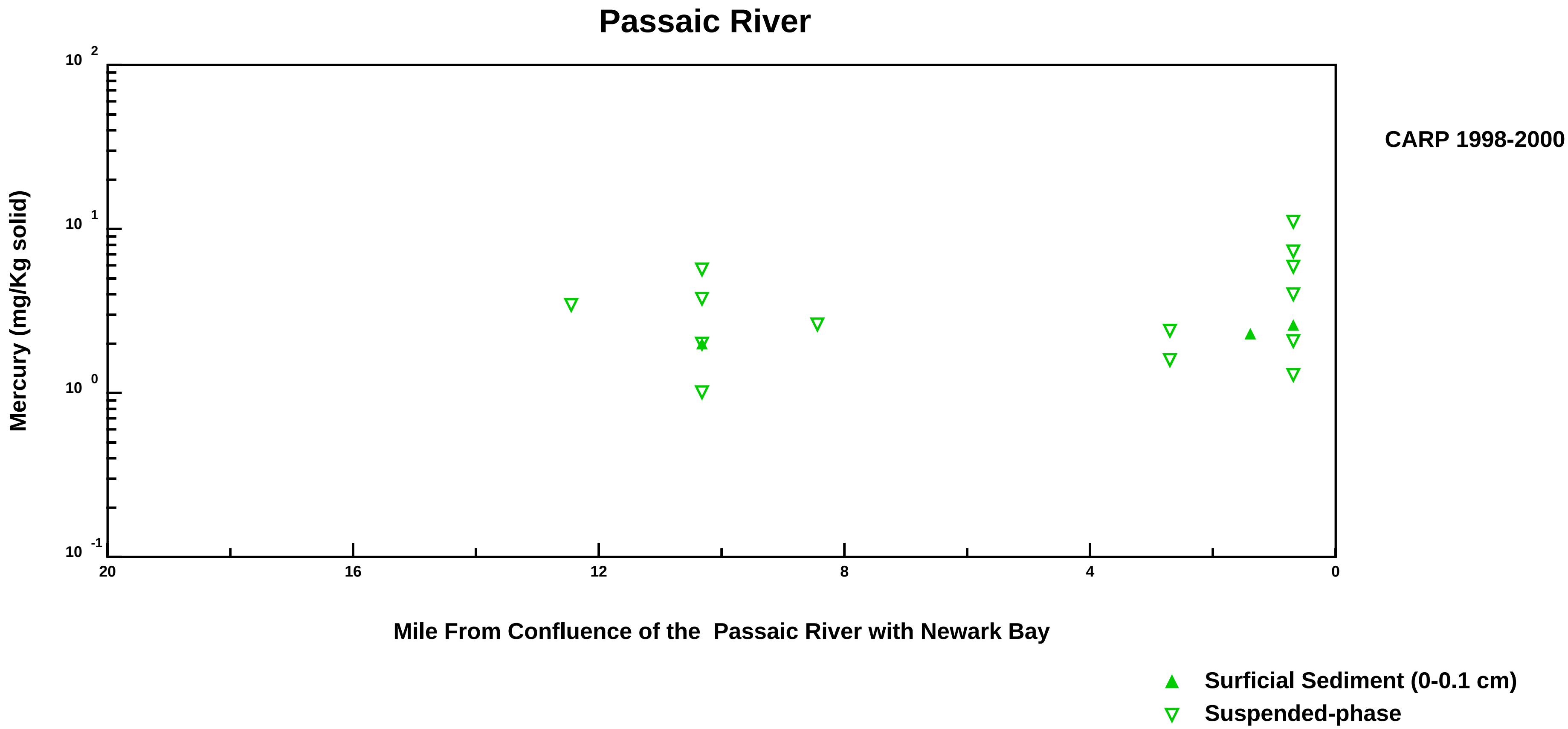


Passaic River
CARP 1998-2000
Dissolved-Mercury (ug/L)
10 -1
10 -2
10 -3
10 -4
20
16
12
8
4
0
CARP 1998-2000
Suspended-Mercury (mg/Kg solid)
10 2
10 1
10 0
10 -1
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay

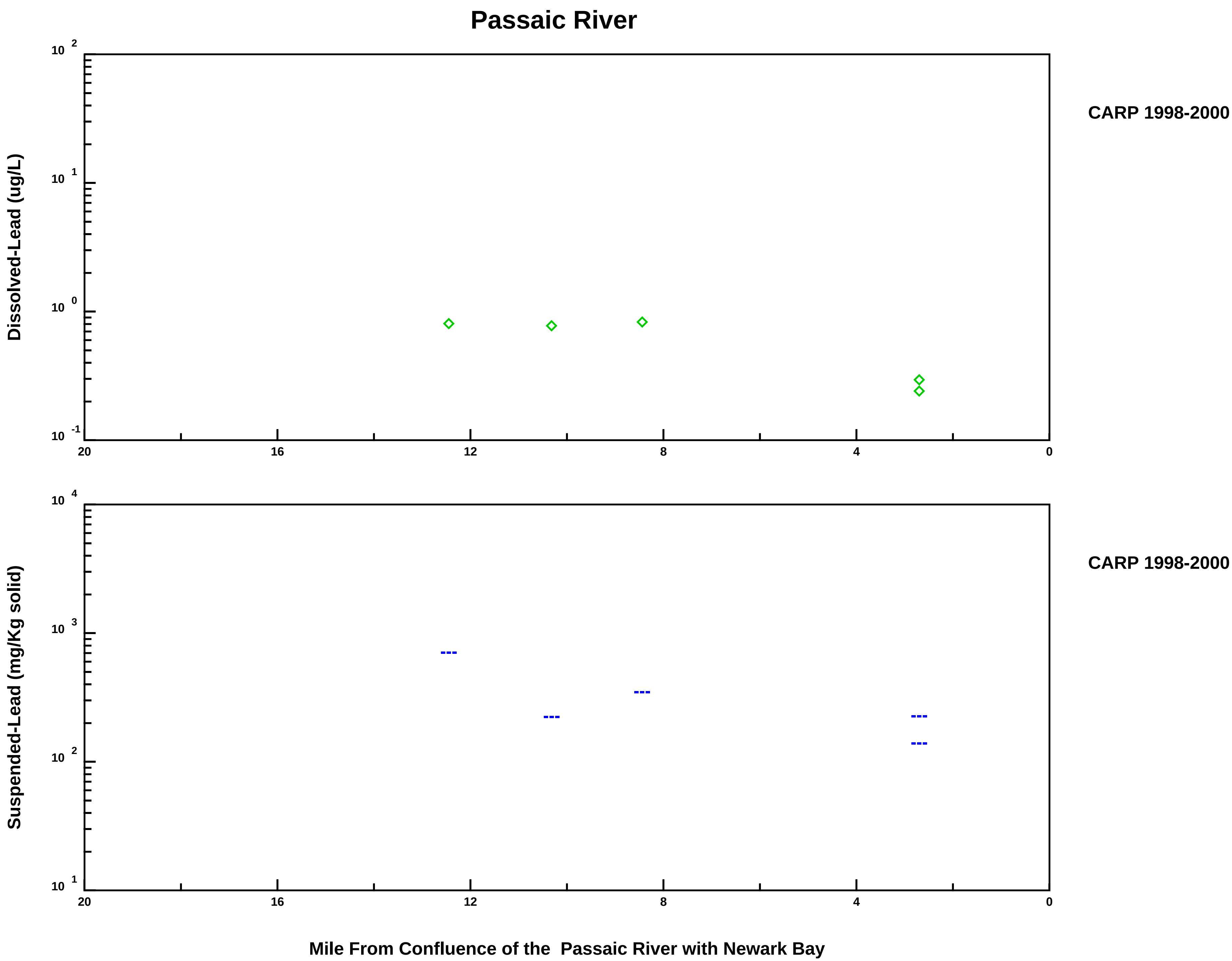
Passaic River





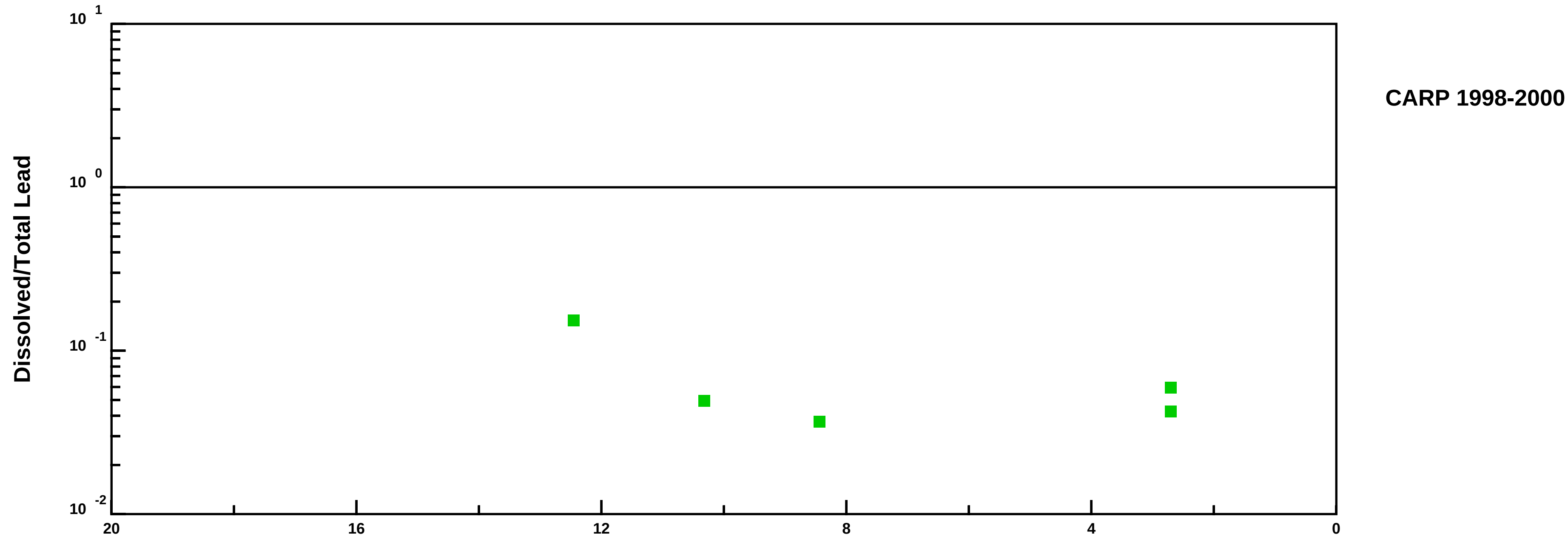


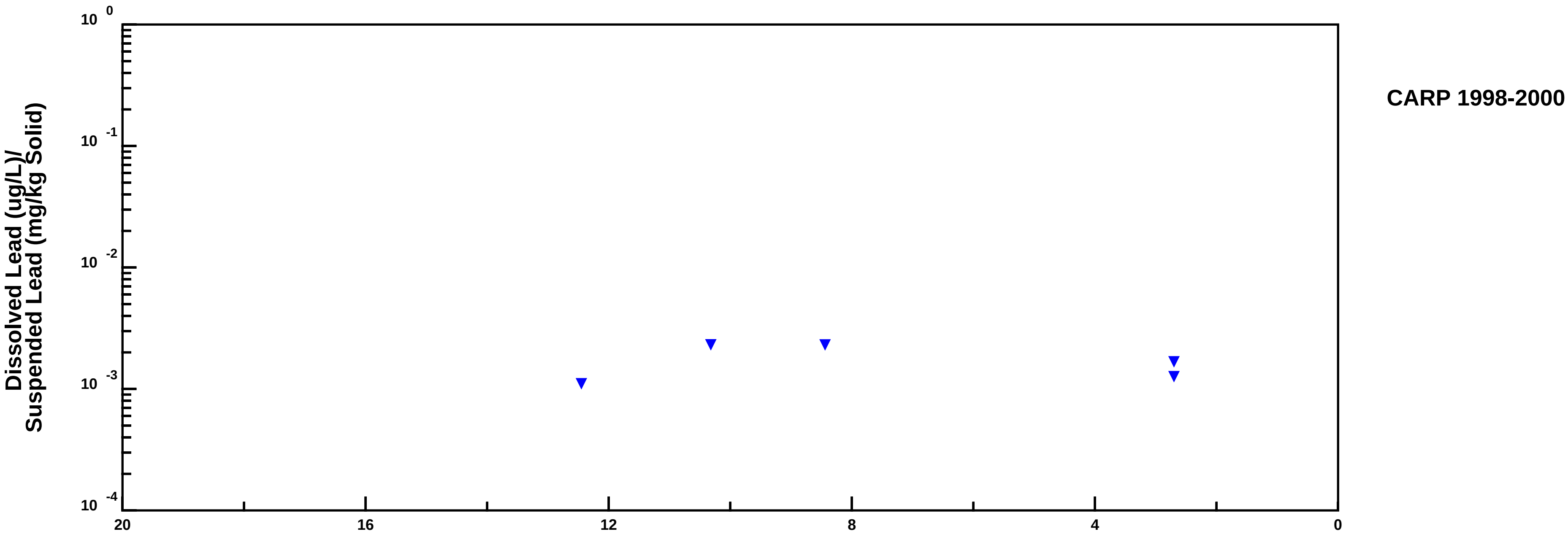
Passaic River
CARP 1998-2000
Mercury (mg/Kg solid)
10 2
10 1
10 0
10 -1
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
Surficial Sediment (0-0.1 cm)
Suspended-phase

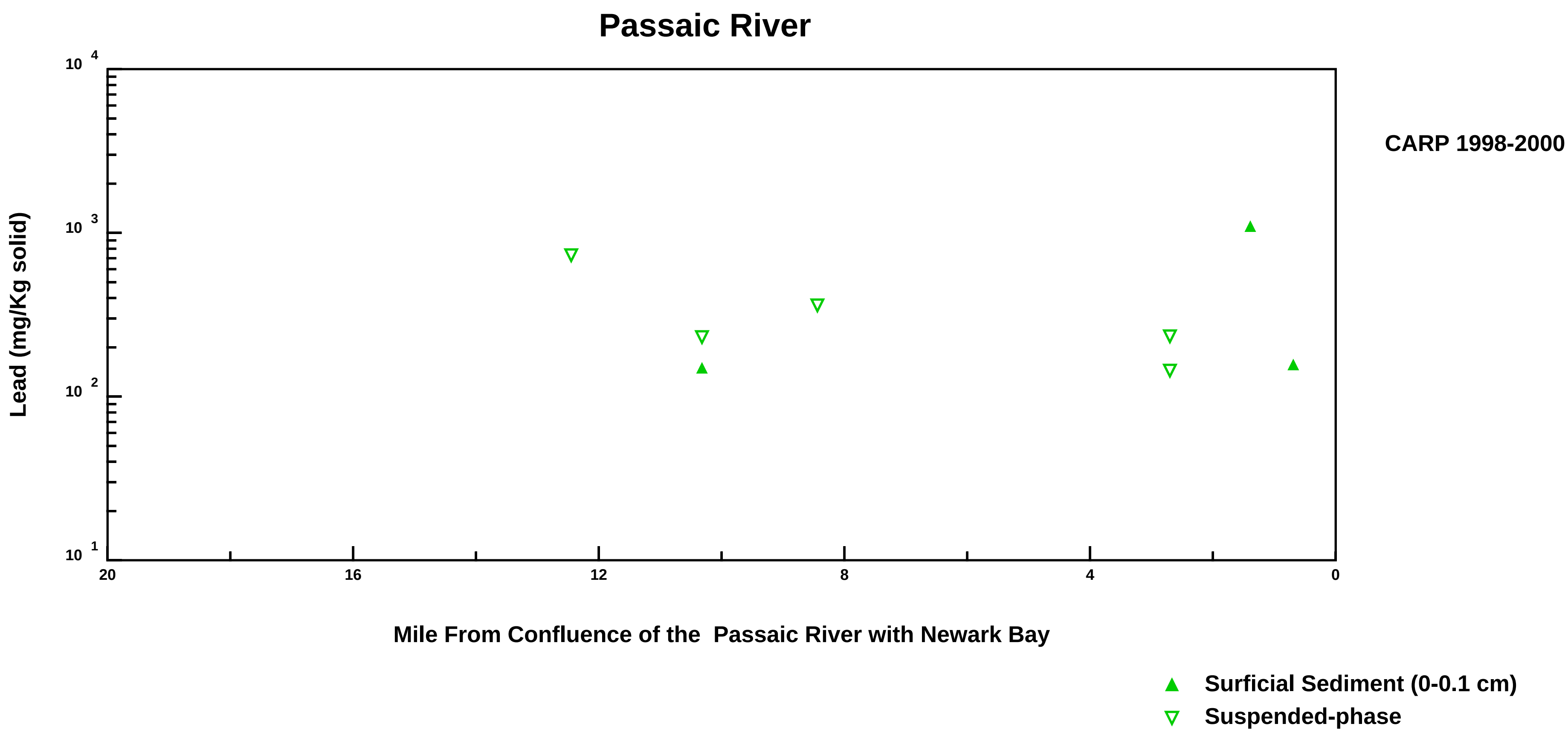


Passaic River
CARP 1998-2000
Dissolved-Lead (ug/L)
10^{2}
10^{1}
10^{0}
10^{-1}
20
16
12
8
4
0
CARP 1998-2000
Suspended-Lead (mg/Kg solid)
10^{4}
10^{3}
10^{2}
10^{1}
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay

Passaic River



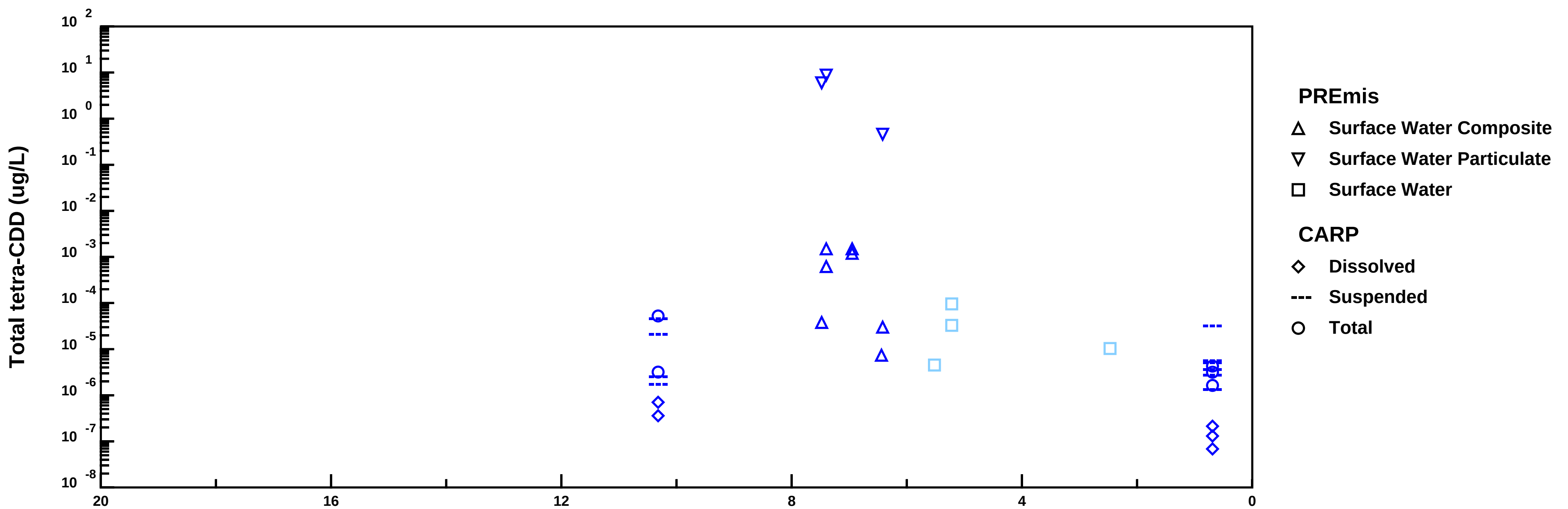


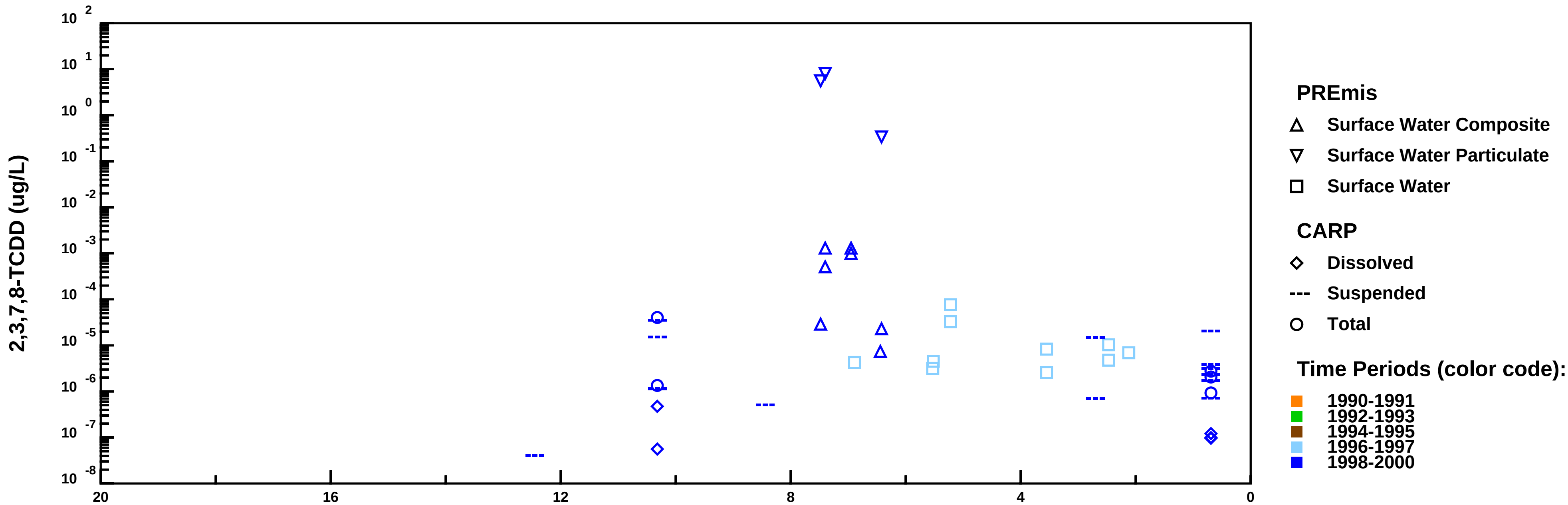


Passaic River
CARP 1998-2000
Lead (mg/Kg solid)
10 4
10 3
10 2
10 1
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
Surficial Sediment (0-0.1 cm)
Suspended-phase

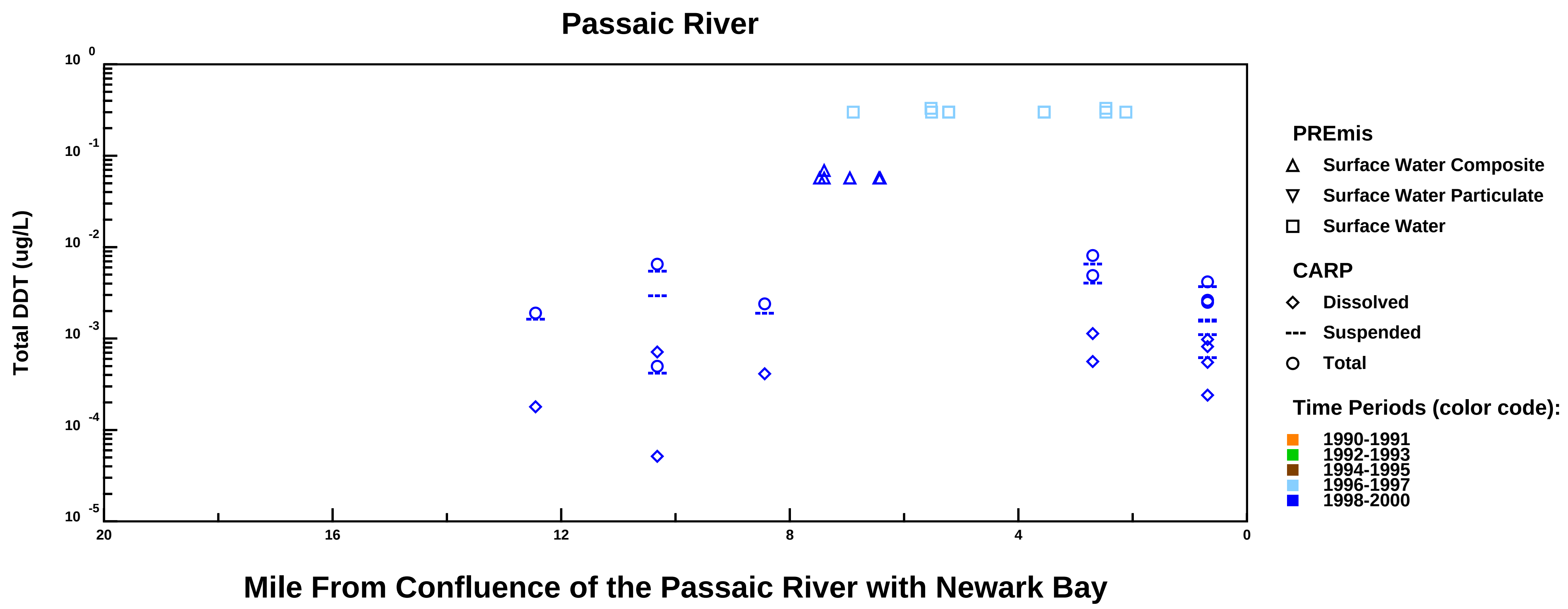
PREmis/CARP WATER COLUMN PLOTS
(PREmis_Passaic_WaterColumn.pdf)

Passaic River

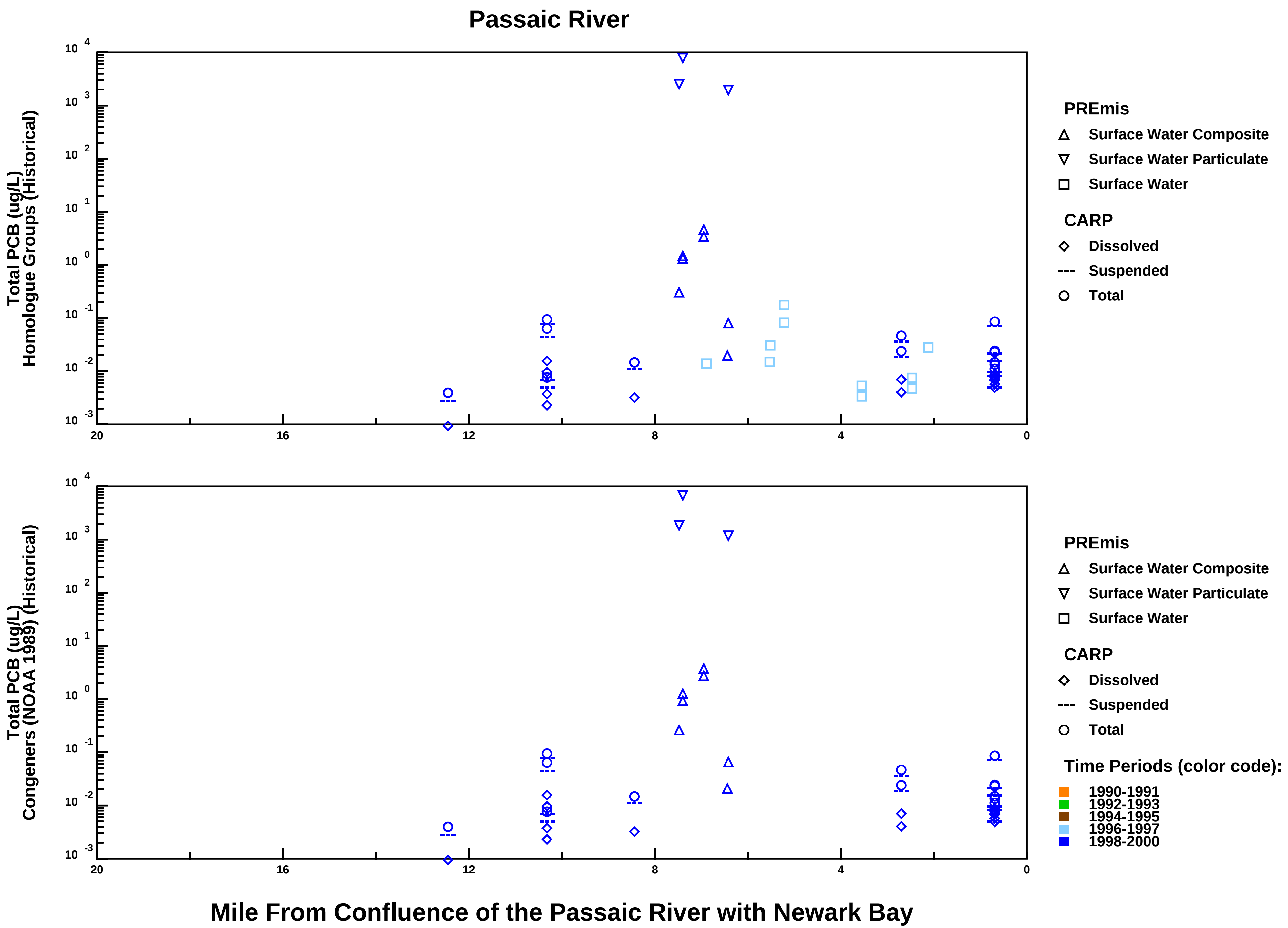


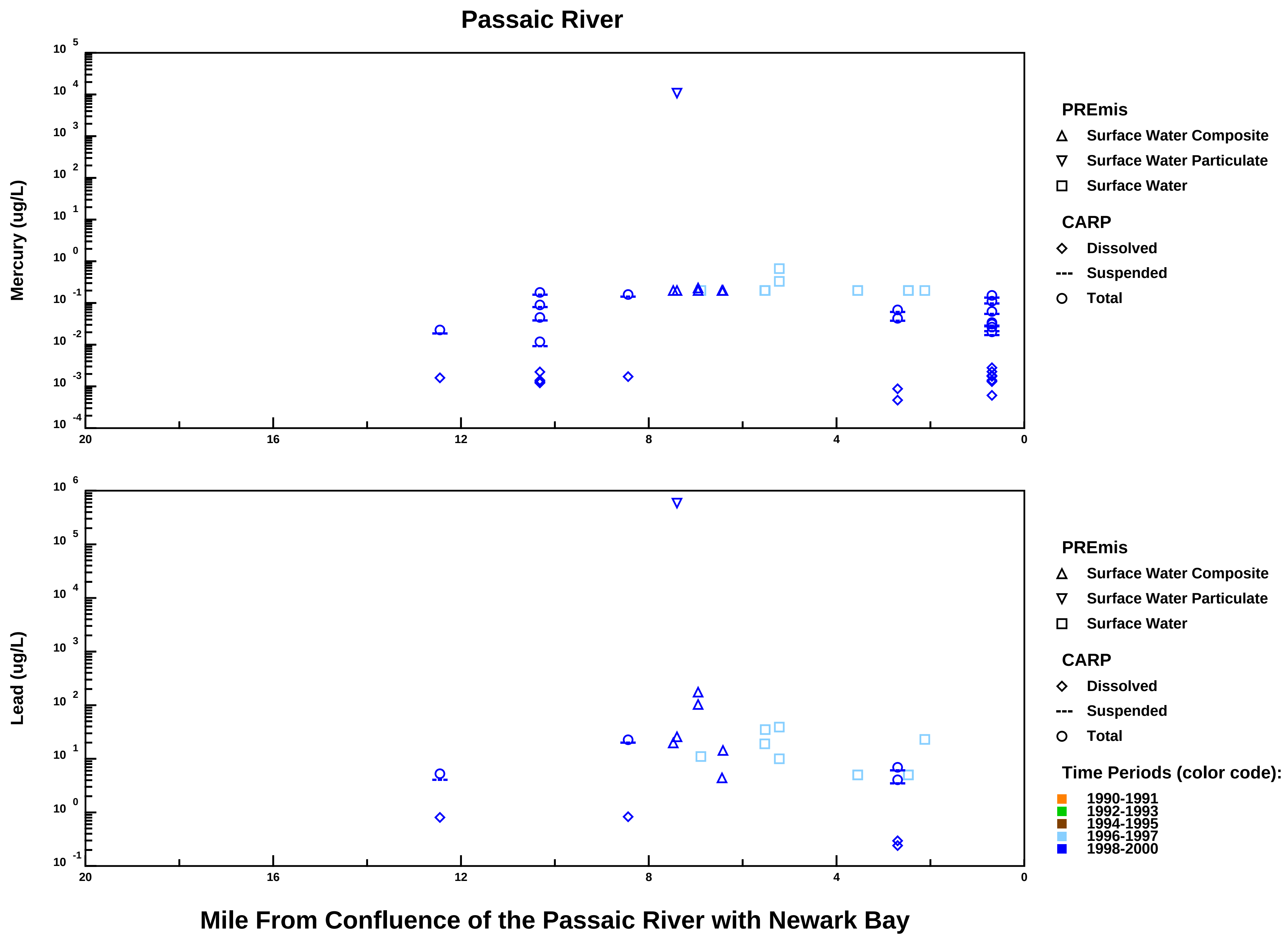


Mile From Confluence of the Passaic River with Newark Bay

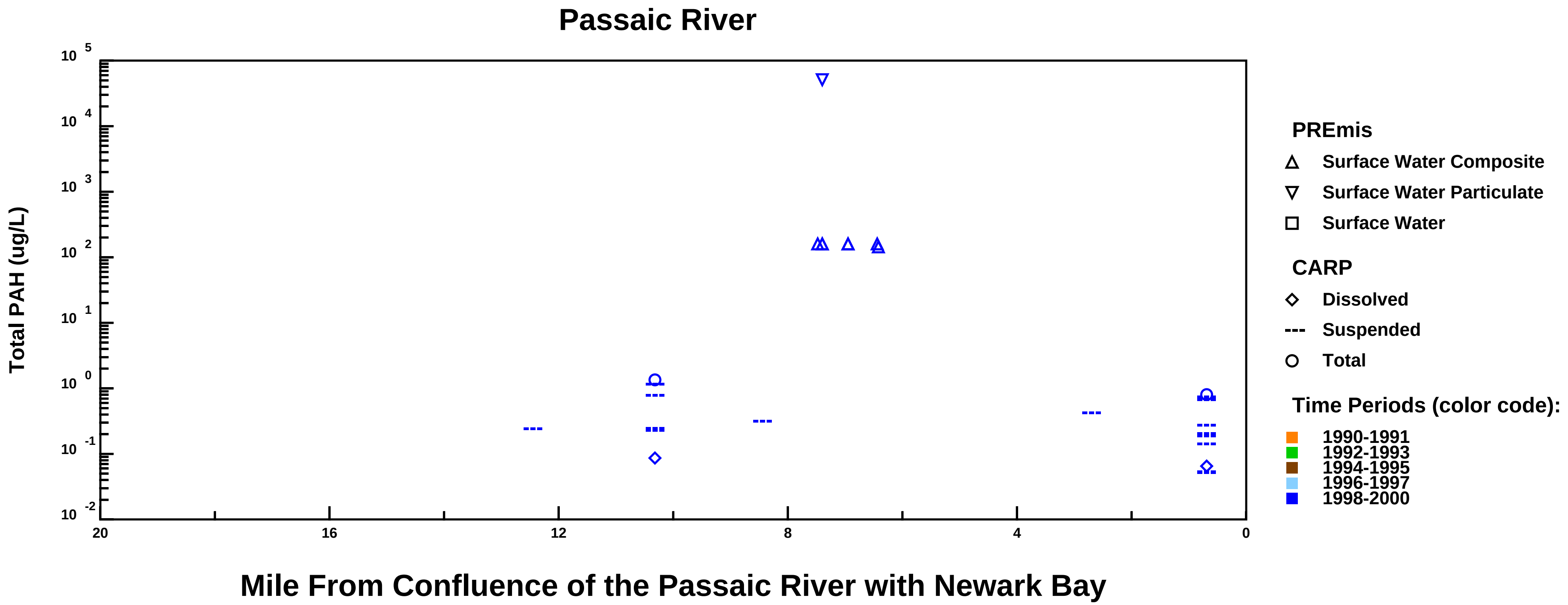


Passaic River
10 0
10 -1
10 -2
10 -3
10 -4
10 -5
Total DDT (ug/L)
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
PREmis
Surface Water Composite
Surface Water Particulate
Surface Water
CARP
Dissolved
Suspended
Total
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000


Passaic River
Total PCB (ug/L) Homologue Groups (Historical)
Total PCB (ug/L) Congeners (NOAA 1989) (Historical)
10 4
10 3
10 2
10 1
10 0
10 -1
10 -2
10 -3
20
16
12
8
4
0
PREmis
Surface Water Composite
Surface Water Particulate
Surface Water
CARP
Dissolved
Suspended
Total
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
Mile From Confluence of the Passaic River with Newark Bay

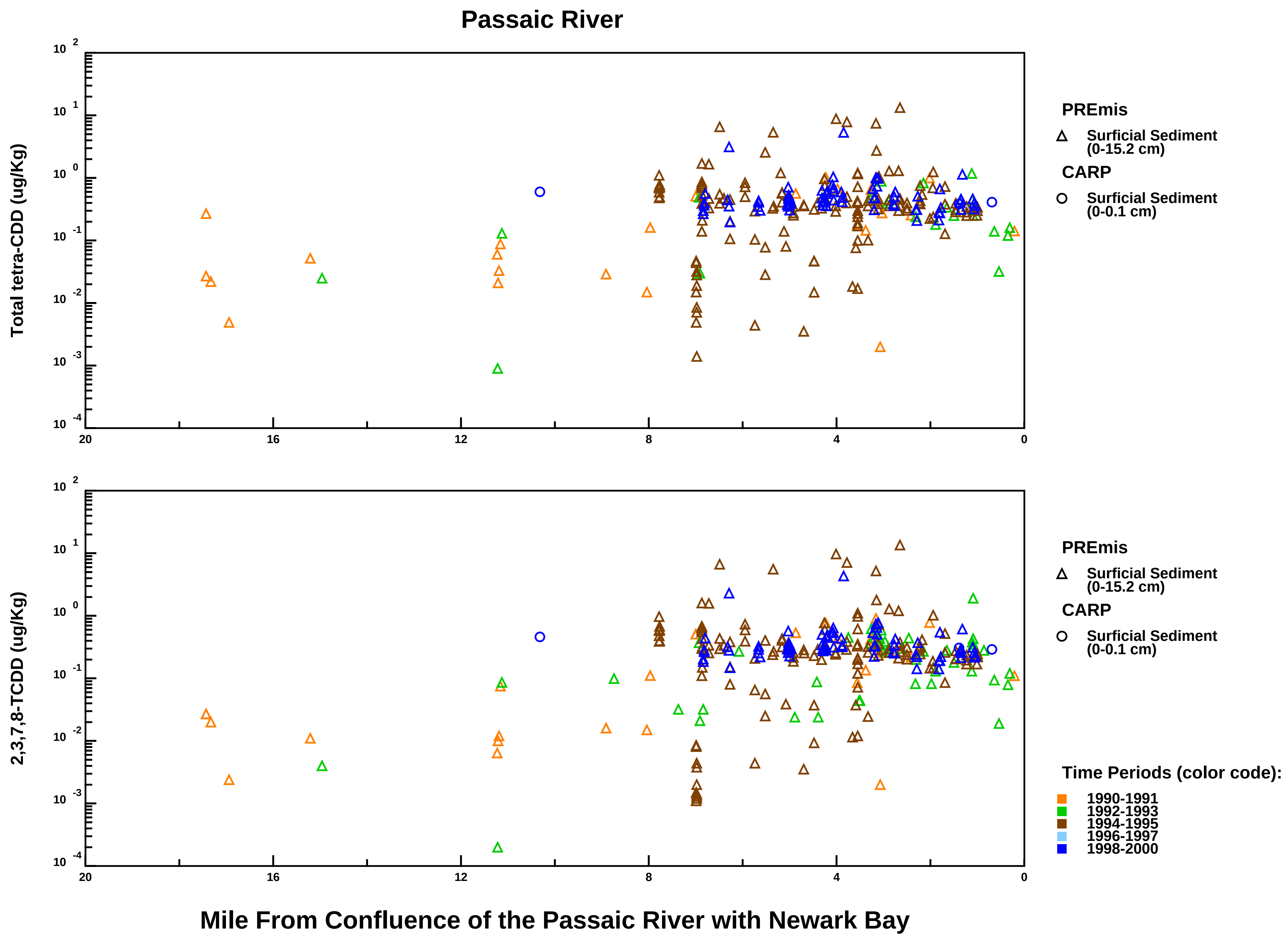


Passaic River
Mercury (ug/L)
Lead (ug/L)
PREmis
Surface Water Composite
Surface Water Particulate
Surface Water
CARP
Dissolved
Suspended
Total
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay

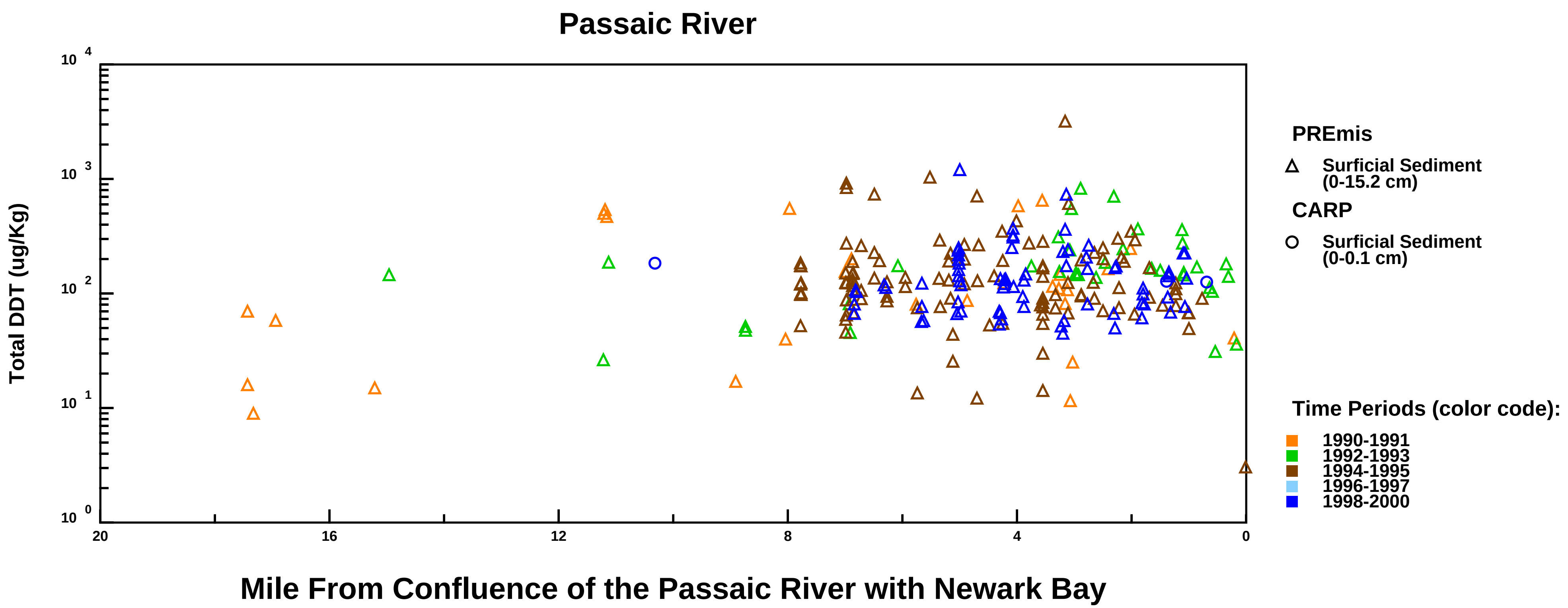


Passaic River
Total PAH (ug/L)
10 5
10 4
10 3
10 2
10 1
10 0
10 -1
10 -2
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
PREmis
Surface Water Composite
Surface Water Particulate
Surface Water
CARP
Dissolved
Suspended
Total
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000

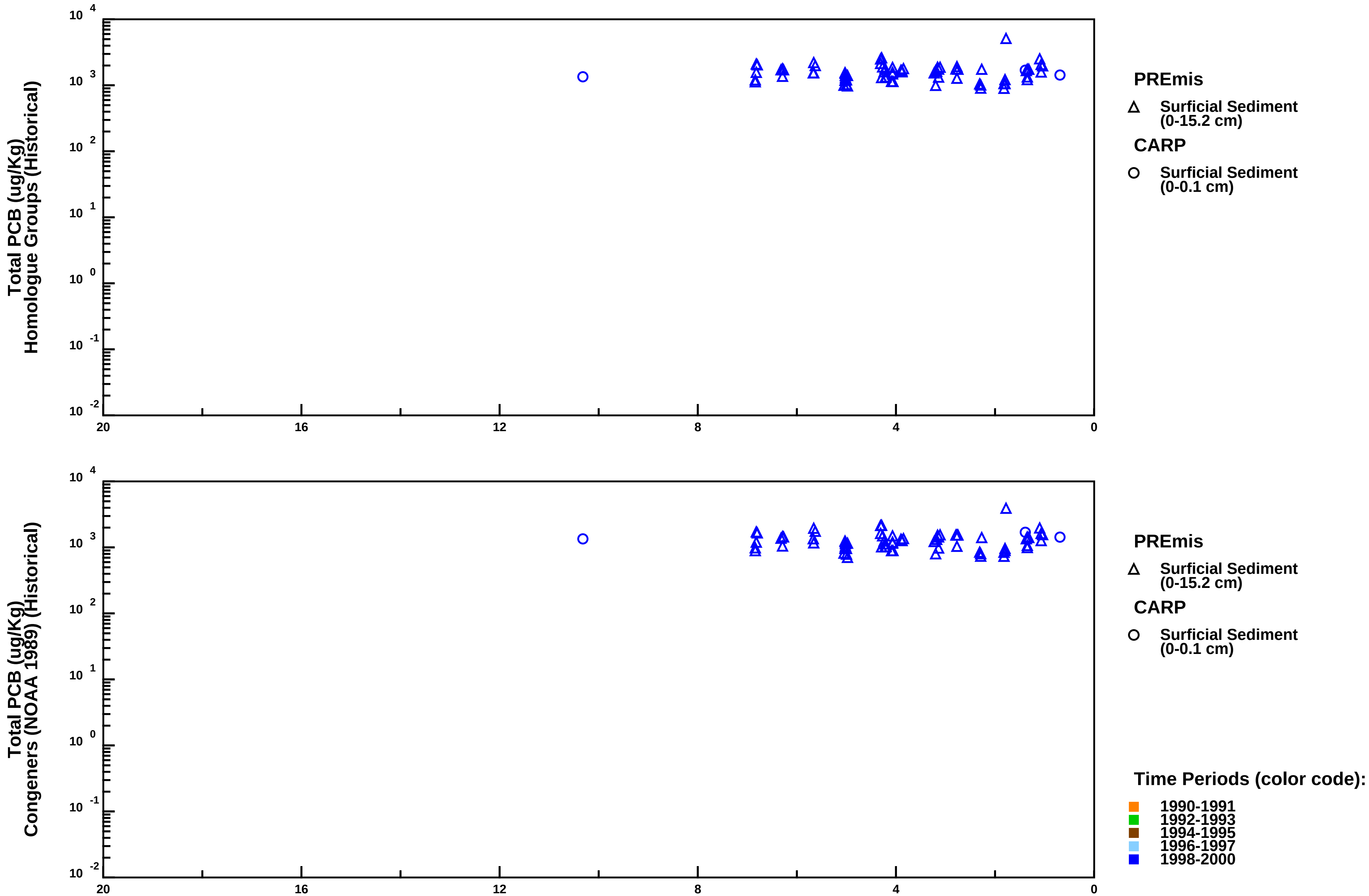
PREmis/CARP SEDIMENT PLOTS
(PREmis_Passaic_Sediment.pdf)



Passaic River
Total tetra-CDD (ug/Kg)
2,3,7,8-TCDD (ug/Kg)
Mile From Confluence of the Passaic River with Newark Bay
PREmis
Surficial Sediment (0-15.2 cm)
CARP
Surficial Sediment (0-0.1 cm)
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000

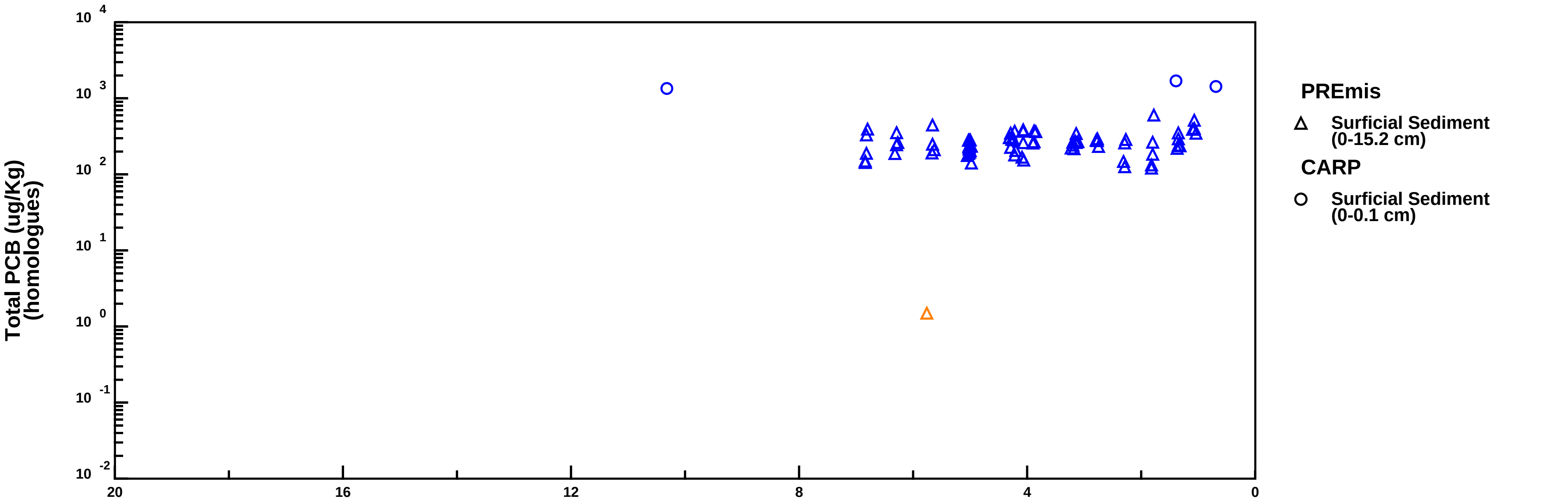

Passaic River
Total DDT (ug/Kg)
10 4
10 3
10 2
10 1
10 0
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
PREmis
Surficial Sediment (0-15.2 cm)
CARP
Surficial Sediment (0-0.1 cm)
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000

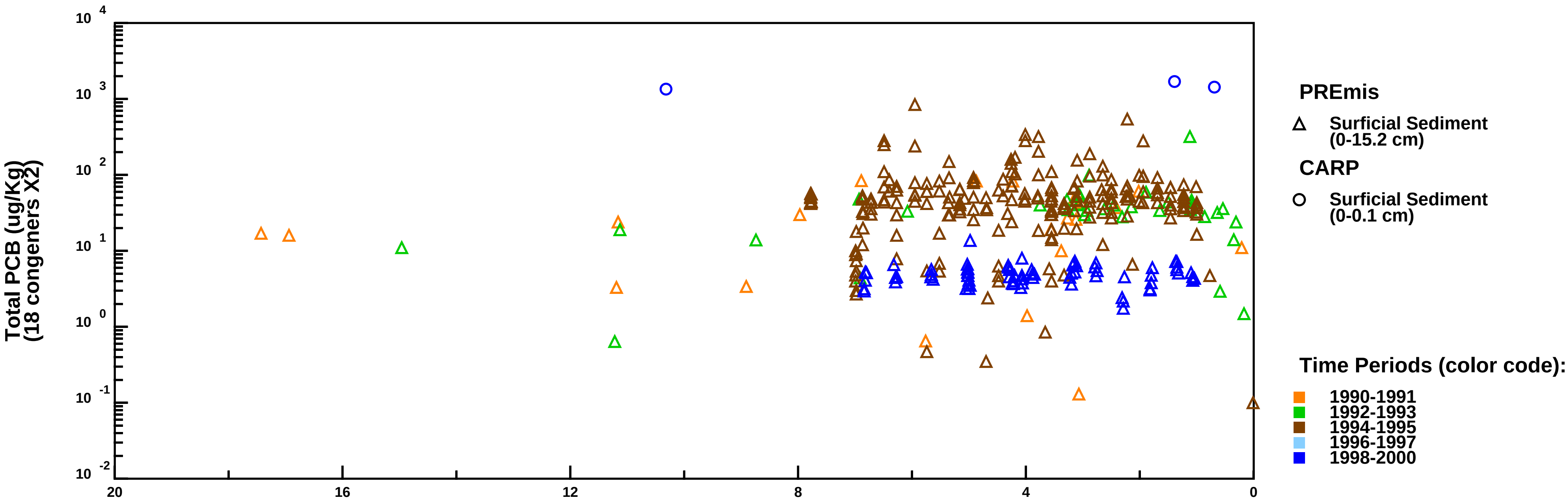
Passaic River



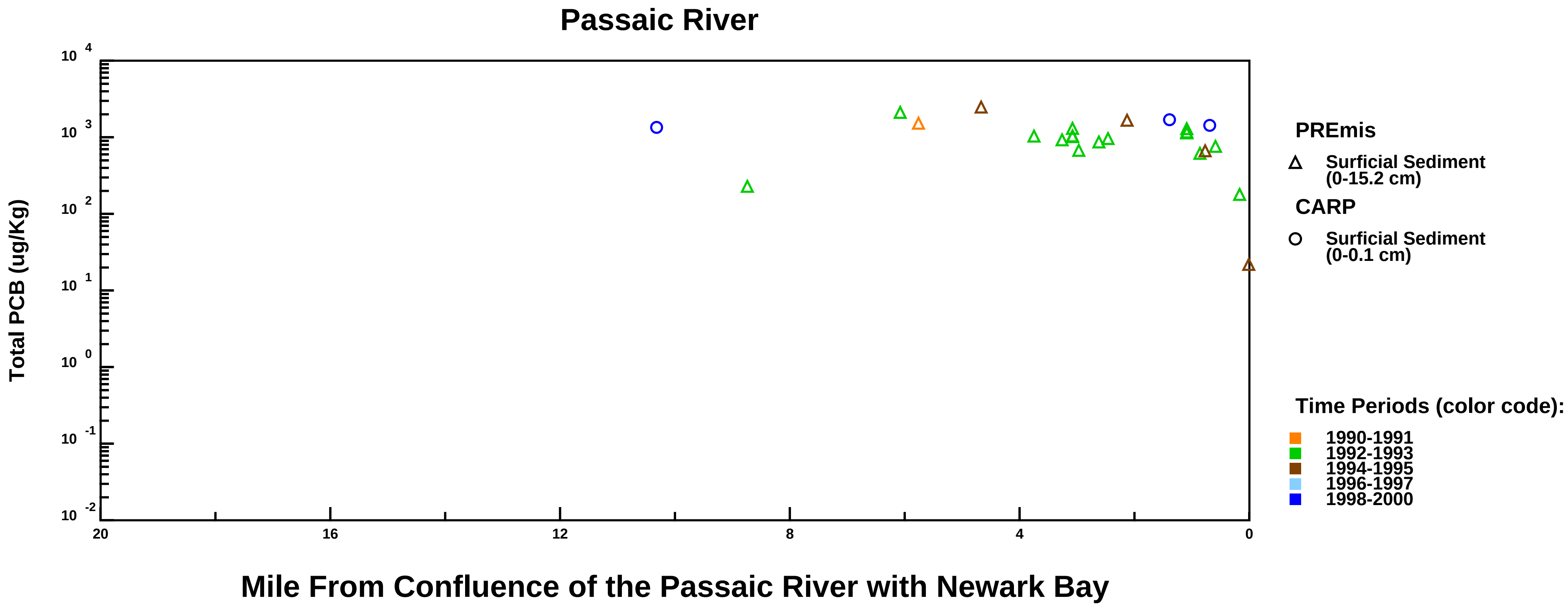
Mile From Confluence of the Passaic River with Newark Bay

Passaic River

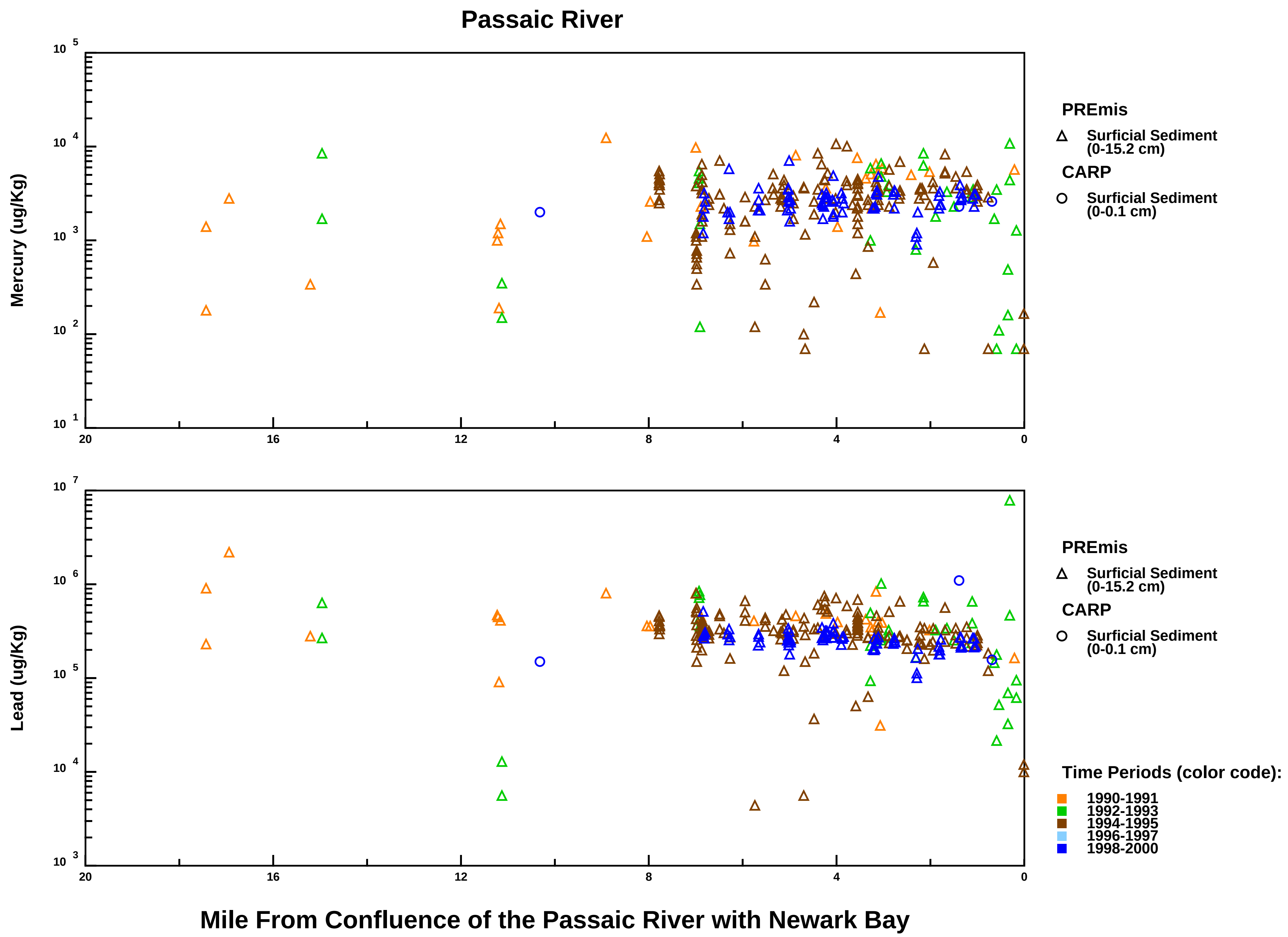




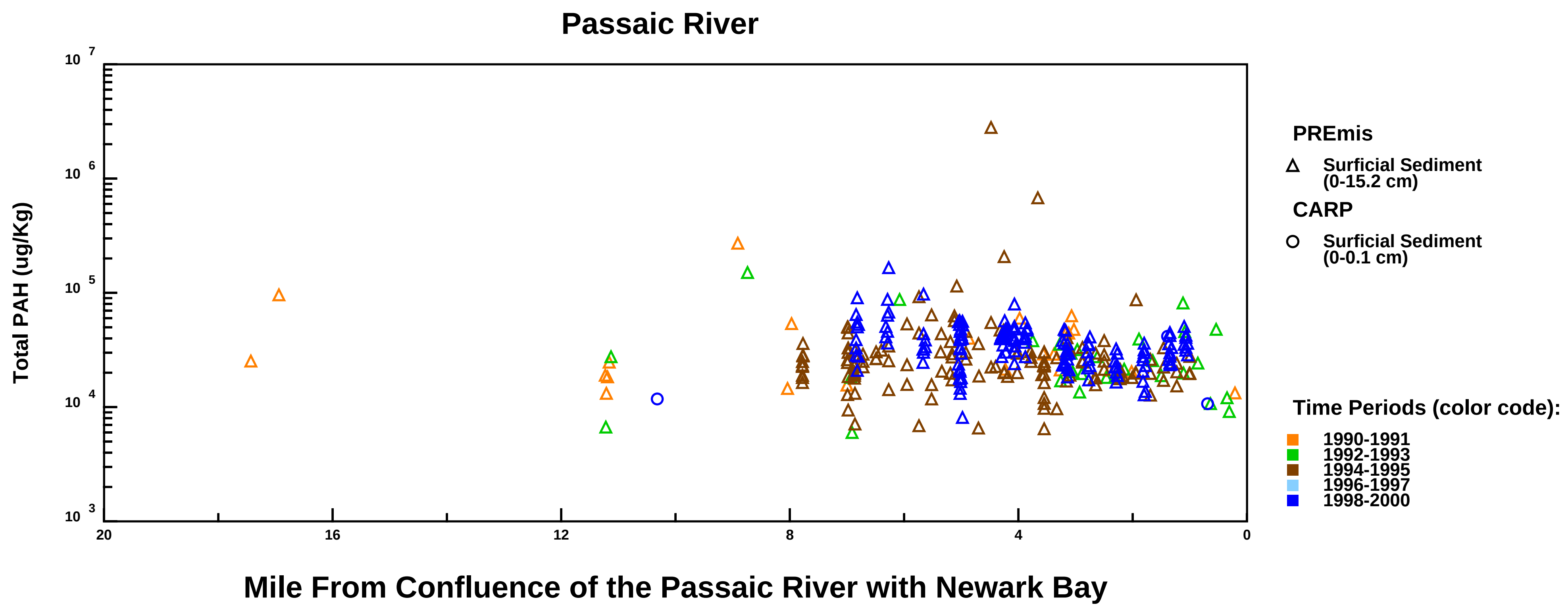
Mile From Confluence of the Passaic River with Newark Bay



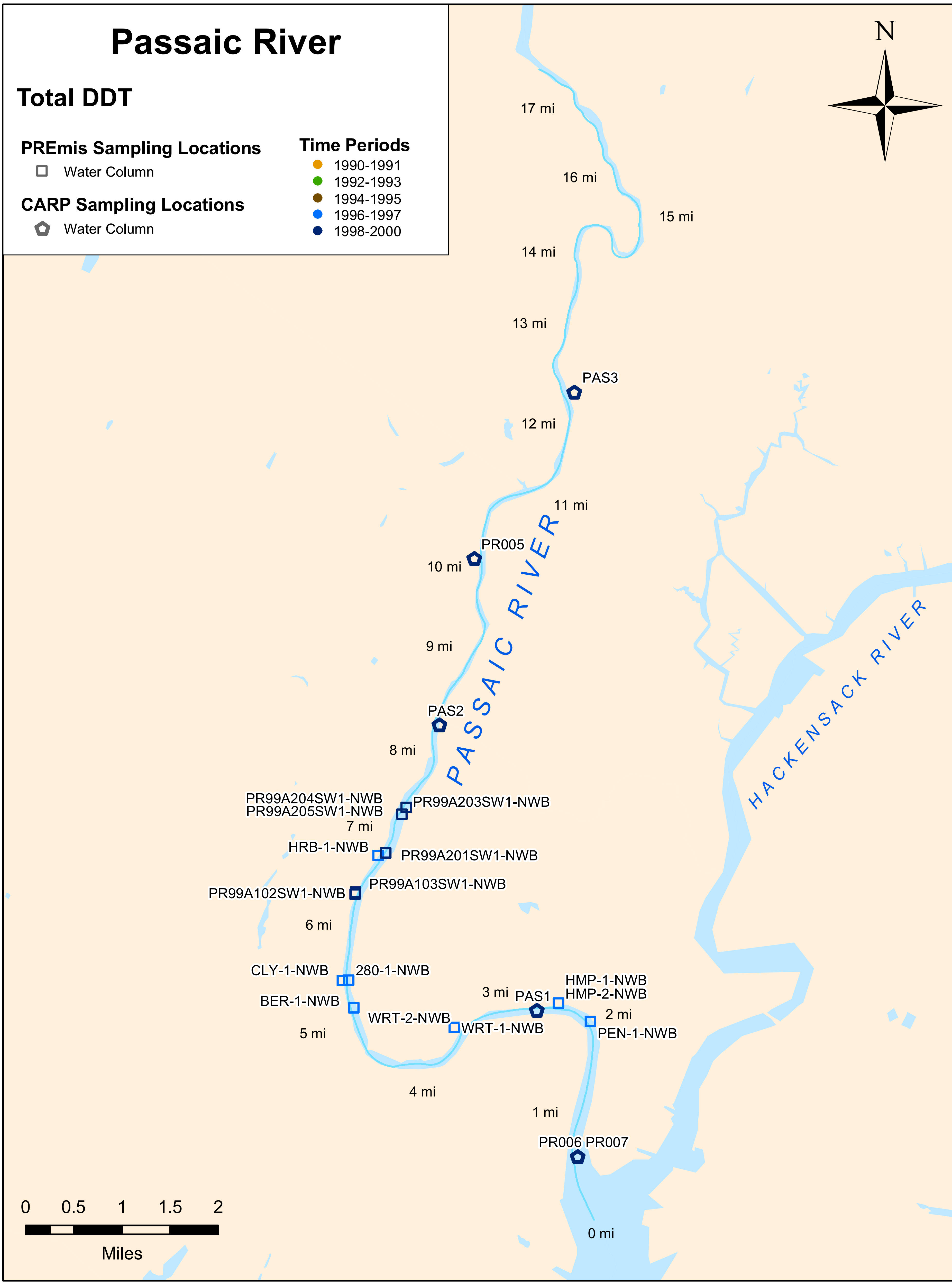
Passaic River
Total PCB (ug/Kg)
10 4
10 3
10 2
10 1
10 0
10 -1
10 -2
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
PREmis
Surficial Sediment (0-15.2 cm)
CARP
Surficial Sediment (0-0.1 cm)
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000

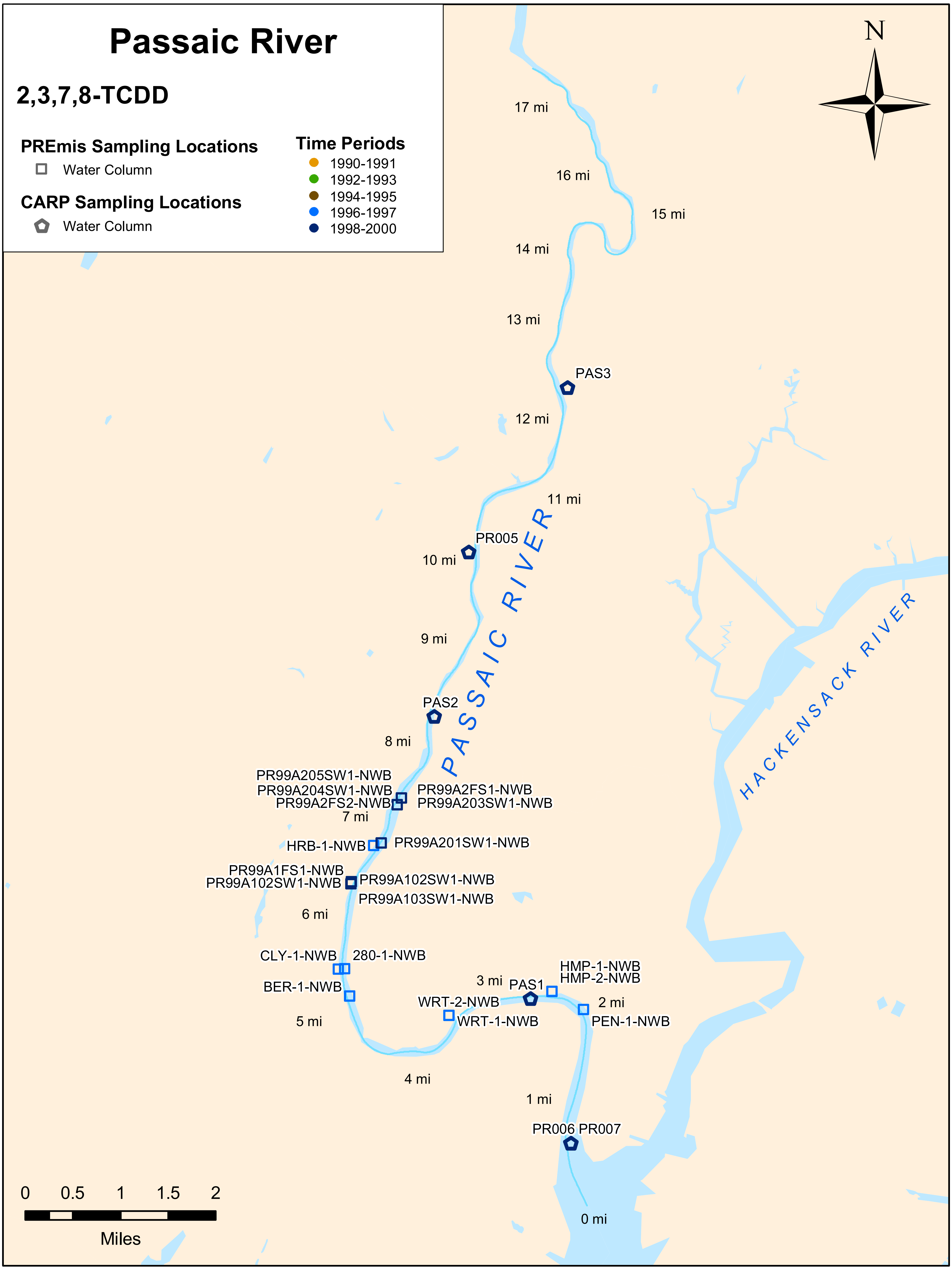


Passaic River
Mercury (ug/Kg)
Lead (ug/Kg)
10 1
10 2
10 3
10 4
10 5
10 6
10 7
20
16
12
8
4
0
PREmis
Surficial Sediment
(0-15.2 cm)
CARP
Surficial Sediment
(0-0.1 cm)
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
Mile From Confluence of the Passaic River with Newark Bay

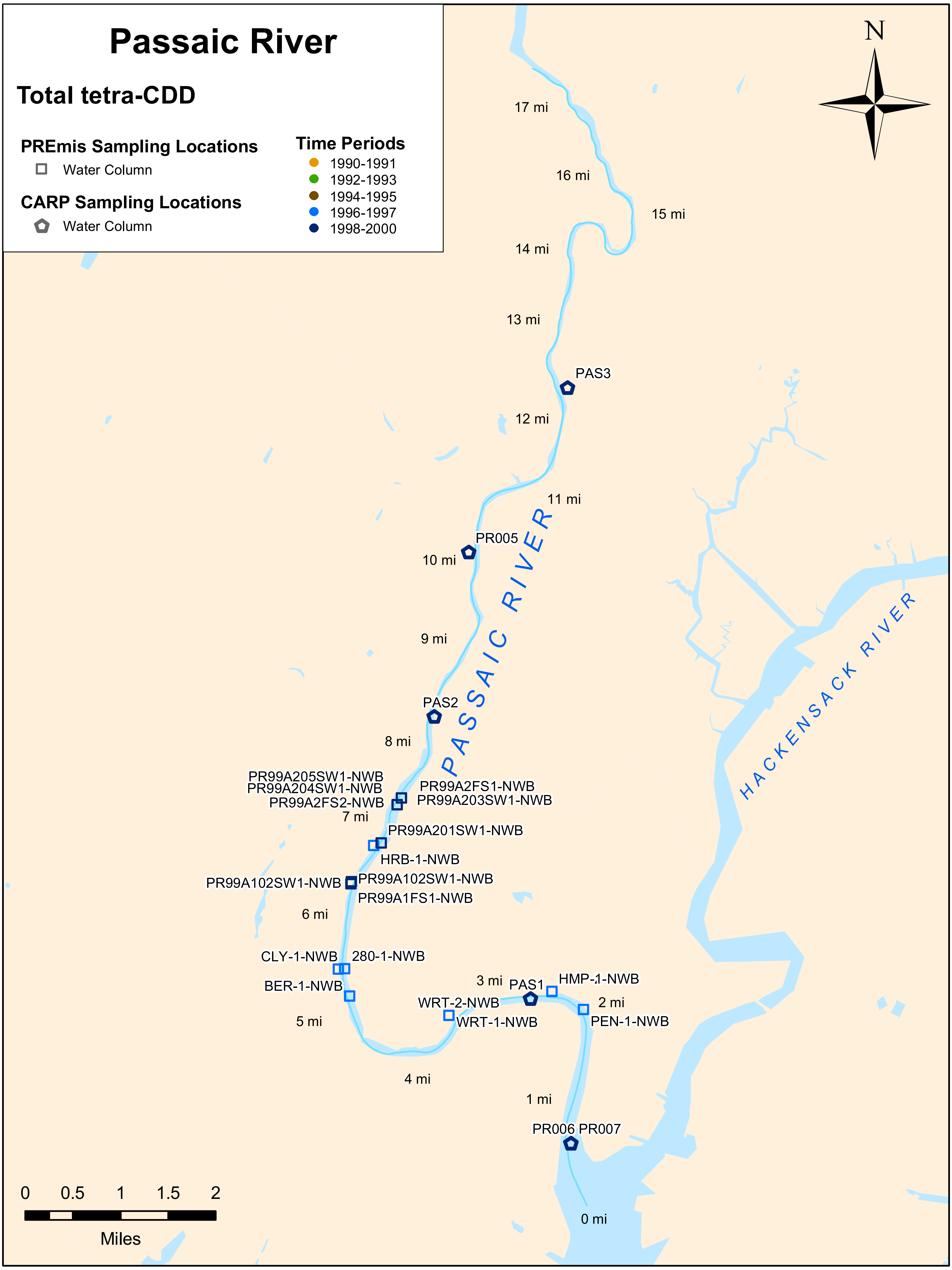


Passaic River
Total PAH (ug/Kg)
10 7
10 6
10 5
10 4
10 3
20
16
12
8
4
0
Mile From Confluence of the Passaic River with Newark Bay
PREmis
Surficial Sediment (0-15.2 cm)
CARP
Surficial Sediment (0-0.1 cm)
Time Periods (color code):
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000

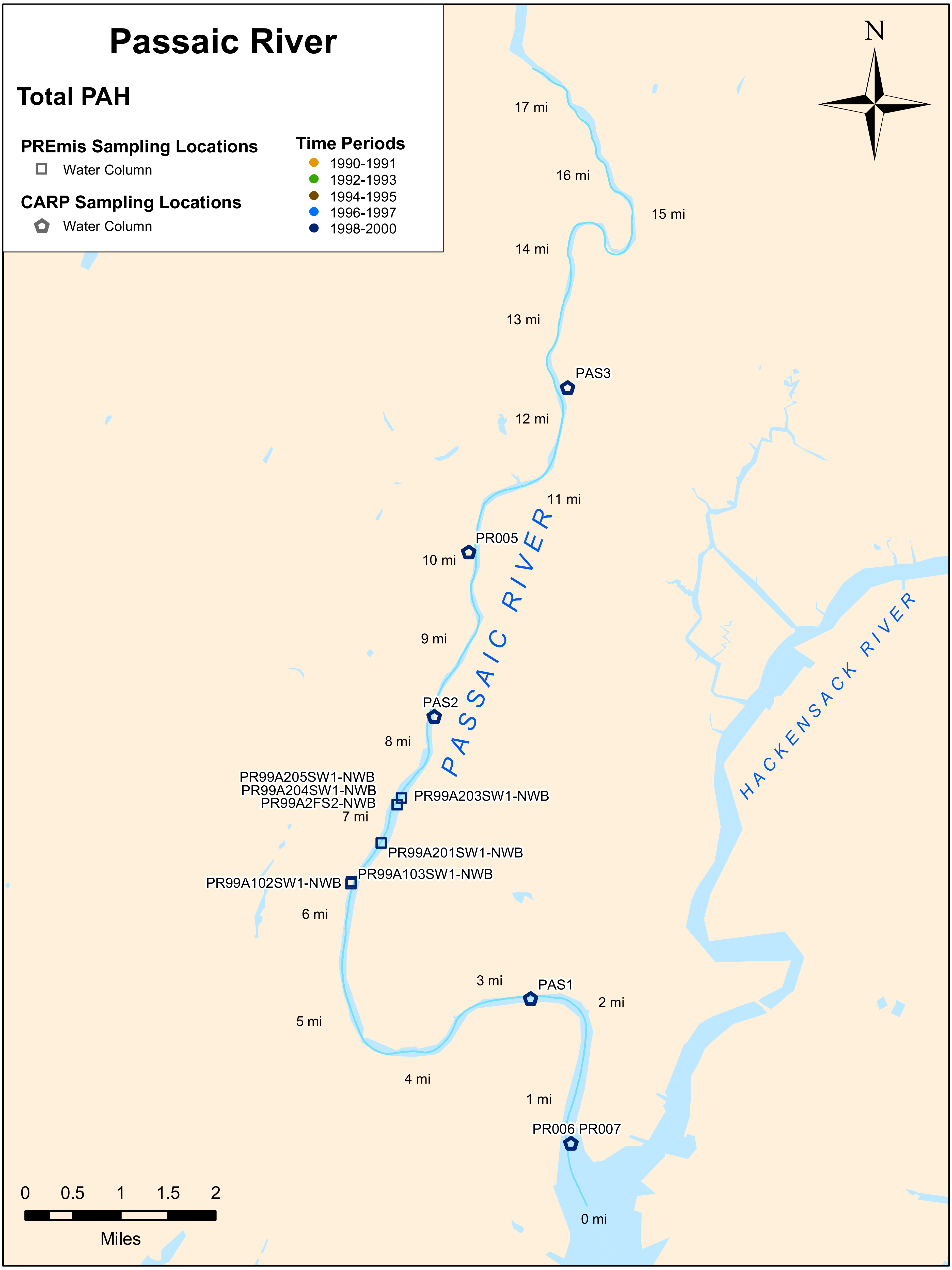

Passaic River
Total DDT
PREmis Sampling Locations
Water Column
CARP Sampling Locations
Water Column
Time Periods
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
N
17 mi
16 mi
15 mi
14 mi
13 mi
PAS3
12 mi
11 mi
PR005
10 mi
PASSAIC RIVER
9 mi
PAS2
8 mi
PR99A204SW1-NWB
PR99A205SW1-NWB
PR99A203SW1-NWB
7 mi
HRB-1-NWB
PR99A201SW1-NWB
PR99A102SW1-NWB
PR99A103SW1-NWB
6 mi
CLY-1-NWB
280-1-NWB
BER-1-NWB
5 mi
WRT-2-NWB
WRT-1-NWB
3 mi
PAS1
HMP-1-NWB
HMP-2-NWB
2 mi
PEN-1-NWB
4 mi
1 mi
PR006 PR007
0 mi
HACKENSACK RIVER
0 0.5 1 1.5 2
Miles

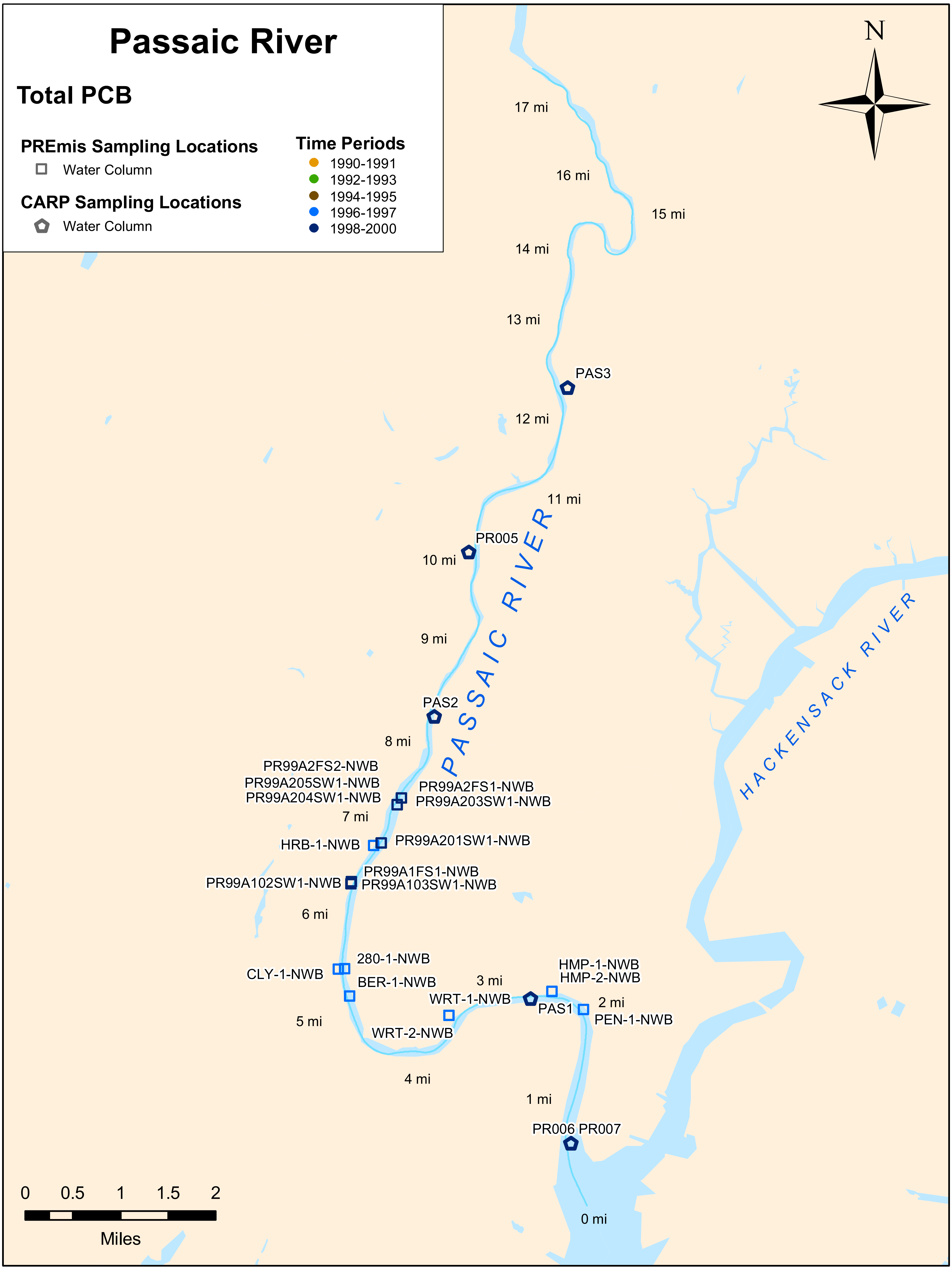


Passaic River
2,3,7,8-TCDD
PREmis Sampling Locations
Water Column
CARP Sampling Locations
Water Column
Time Periods
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
N
PASSAIC RIVER
HACKENSACK RIVER
17 mi
16 mi
15 mi
14 mi
13 mi
12 mi
11 mi
10 mi
9 mi
8 mi
7 mi
6 mi
5 mi
4 mi
3 mi
2 mi
1 mi
0 mi
PAS3
PR005
PAS2
PR99A205SW1-NWB
PR99A204SW1-NWB
PR99A2FS2-NWB
PR99A2FS1-NWB
PR99A203SW1-NWB
HRB-1-NWB
PR99A201SW1-NWB
PR99A1FS1-NWB
PR99A102SW1-NWB
PR99A102SW1-NWB
PR99A103SW1-NWB
CLY-1-NWB
280-1-NWB
BER-1-NWB
WRT-2-NWB
WRT-1-NWB
PAS1
HMP-1-NWB
HMP-2-NWB
PEN-1-NWB
PR006 PR007
0
0.5
1
1.5
2
Miles

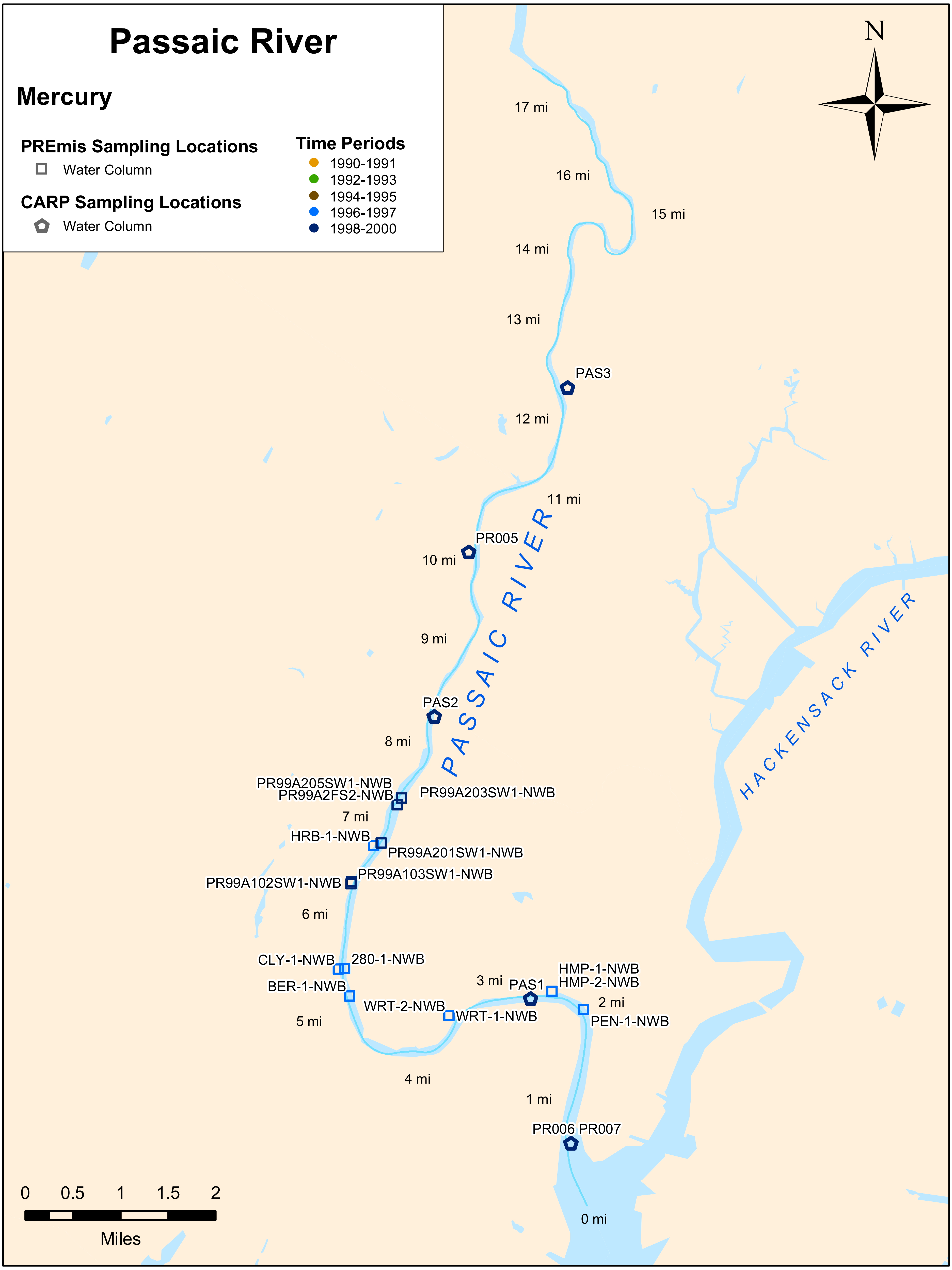


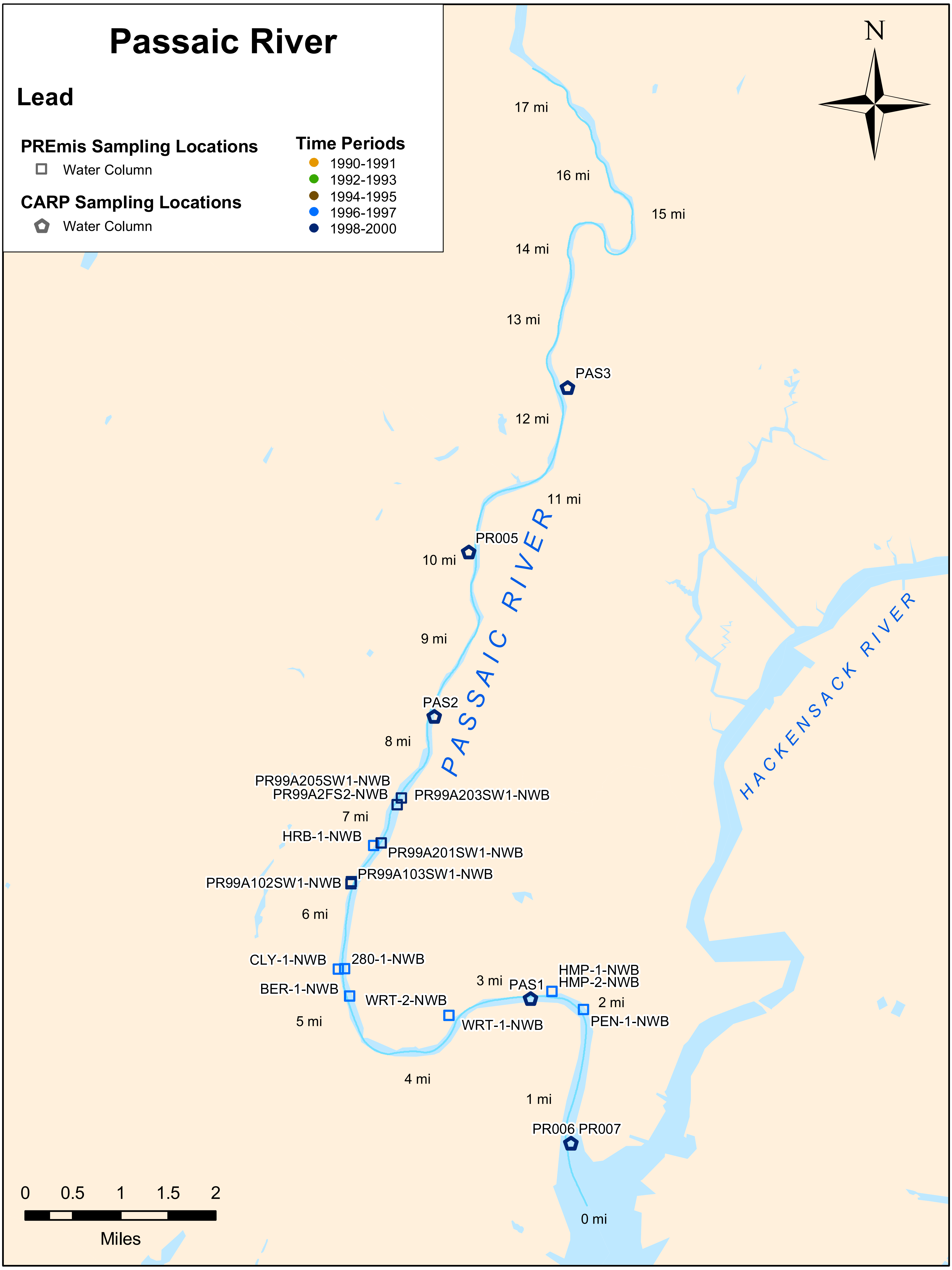
Passaic River
Total tetra-CDD
PREmis Sampling Locations
Water Column
CARP Sampling Locations
Water Column
Time Periods
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
N
17 mi
16 mi
15 mi
14 mi
13 mi
PAS3
12 mi
11 mi
PR005
10 mi
PASSAIC RIVER
9 mi
PAS2
8 mi
HACKENSACK RIVER
PR99A205SW1-NWB
PR99A204SW1-NWB
PR99A2FS2-NWB
PR99A2FS1-NWB
PR99A203SW1-NWB
7 mi
PR99A201SW1-NWB
HRB-1-NWB
PR99A102SW1-NWB
PR99A102SW1-NWB
PR99A1FS1-NWB
6 mi
CLY-1-NWB
280-1-NWB
BER-1-NWB
3 mi
PAS1
HMP-1-NWB
WRT-2-NWB
2 mi
WRT-1-NWB
PEN-1-NWB
5 mi
4 mi
1 mi
PR006 PR007
0 mi
0 0.5 1 1.5 2
Miles


Passaic River
Total PAH
PREmis Sampling Locations
Water Column
CARP Sampling Locations
Water Column
Time Periods
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
N
17 mi
16 mi
15 mi
14 mi
13 mi
PAS3
12 mi
11 mi
PR005
10 mi
9 mi
PASSAIC RIVER
PAS2
8 mi
PR99A205SW1-NWB
PR99A204SW1-NWB
PR99A2FS2-NWB
PR99A203SW1-NWB
7 mi
PR99A201SW1-NWB
PR99A103SW1-NWB
PR99A102SW1-NWB
6 mi
HACKENSACK RIVER
3 mi
PAS1
2 mi
5 mi
4 mi
1 mi
PR006 PR007
0 mi
0 0.5 1 1.5 2
Miles



Passaic River
Total PCB
PREmis Sampling Locations
Water Column
CARP Sampling Locations
Water Column
Time Periods
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
N
17 mi
16 mi
15 mi
14 mi
13 mi
PAS3
12 mi
11 mi
PR005
10 mi
PASSAIC RIVER
9 mi
PAS2
8 mi
PR99A2FS2-NWB
PR99A205SW1-NWB
PR99A204SW1-NWB
PR99A2FS1-NWB
PR99A203SW1-NWB
7 mi
HRB-1-NWB
PR99A201SW1-NWB
PR99A1FS1-NWB
PR99A102SW1-NWB
PR99A103SW1-NWB
6 mi
280-1-NWB
CLY-1-NWB
BER-1-NWB
3 mi
HMP-1-NWB
HMP-2-NWB
WRT-1-NWB
PAS1
2 mi
PEN-1-NWB
5 mi
WRT-2-NWB
4 mi
1 mi
PR006 PR007
0 mi
HACKENSACK RIVER
0 0.5 1 1.5 2
Miles


Passaic River
Mercury
PREmis Sampling Locations
Water Column
CARP Sampling Locations
Water Column
Time Periods
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
N
17 mi
16 mi
15 mi
14 mi
13 mi
PAS3
12 mi
11 mi
PR005
10 mi
PASSAIC RIVER
9 mi
PAS2
8 mi
HACKENSACK RIVER
PR99A205SW1-NWB
PR99A2FS2-NWB
PR99A203SW1-NWB
7 mi
HRB-1-NWB
PR99A201SW1-NWB
PR99A103SW1-NWB
PR99A102SW1-NWB
6 mi
CLY-1-NWB
280-1-NWB
BER-1-NWB
3 mi
PAS1
HMP-1-NWB
HMP-2-NWB
2 mi
WRT-2-NWB
WRT-1-NWB
PEN-1-NWB
5 mi
4 mi
1 mi
PR006 PR007
0 mi
0
0.5
1
1.5
2
Miles


Passaic River
Lead
PREmis Sampling Locations
Water Column
CARP Sampling Locations
Water Column
Time Periods
1990-1991
1992-1993
1994-1995
1996-1997
1998-2000
N
17 mi
16 mi
15 mi
14 mi
13 mi
PAS3
12 mi
11 mi
PR005
10 mi
PASSAIC RIVER
9 mi
PAS2
8 mi
HACKENSACK RIVER
PR99A205SW1-NWB
PR99A2FS2-NWB
PR99A203SW1-NWB
7 mi
HRB-1-NWB
PR99A201SW1-NWB
PR99A103SW1-NWB
PR99A102SW1-NWB
6 mi
CLY-1-NWB
280-1-NWB
HMP-1-NWB
HMP-2-NWB
3 mi
PAS1
BER-1-NWB
WRT-2-NWB
2 mi
PEN-1-NWB
5 mi
WRT-1-NWB
4 mi
1 mi
PR006 PR007
0 mi
0
0.5
1
1.5
2
Miles

Attachment 7: Malcolm Pirnie Water Column Data Compilation

Malcolm Pirnie, Inc. preliminary compilation of water column data available from the CARP databases. PCB homologue distribution coefficients (K_D) for each of seven stations are presented in tabular format. PCB homologue profiles, which show the relative contribution of each homologue or homologue group to total PCBs at each station, are presented graphically.

Malcolm Pirnie Water Column Compilation
Distribution Coefficients (K_D)

STATION: PASS (Little Falls)

Flow Type	Baseflow				Variable				Storm				Baseflow			
Sampling Date	06/22/00				12/15/00				03/14/01				10/17/01			
PCB Homologue	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]
Mono + Di	189	46.7	2.92	4.19	146	1240	181	6.10	131	44.7	2.64	4.31	233	52.9	5.66	4.39
Tri	679	333	20.8	4.49	436	4880	714	6.21	457	431	25.5	4.75	720	200	21.4	4.47
Tetra	672	878	54.8	4.91	241	8950	1310	6.73	518	1100	64.9	5.10	646	487	52.1	4.91
Penta	242	1140	71.2	5.47	95.4	8180	1200	7.10	147	1040	61.4	5.62	249	757	80.9	5.51
Hexa	76.5	730	45.6	5.78	6.33	5760	842	8.12	34.1	537	31.7	5.97	65.1	409	43.8	5.83
Hepta	11.8	280	17.5	6.17	N/A	2750	401	N/A	4.65	228	13.5	6.46	9.23	166	17.8	6.28
Octa	N/A	110	6.89	N/A	N/A	895	131	N/A	N/A	77.8	4.60	N/A	1.39	62.9	6.72	6.69
Nona + Deca	N/A	46.0	2.88	N/A	N/A	452	66.2	N/A	N/A	35.8	2.12	N/A	N/A	32.5	3.48	N/A
Total PCB	1870	3560	223	N/A	924	33100	4840	N/A	1290	3490	206	N/A	1920	2170	232	N/A

STATION: PAS1 (RM 2.70)

Sampling Date	06/21/00				12/15/00				03/15/01				10/19/01				03/12/02			
PCB Homologue	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]
Mono + Di	751	884	22.6	4.48	615	528	16.5	4.43	403	221	23.4	4.76	356	1420	21.0	4.77	348	303	32.1	4.96
Tri	2597	4250	109	4.62	1760	2580	80.3	4.66	1280	979	104	4.91	1780	6720	100	4.75	1470	1540	163	5.05
Tetra	2681	1250	319	5.08	1330	5810	181	5.13	993	2300	244	5.39	1640	11900	177	5.03	1100	3180	337	5.49
Penta	668	8550	219	5.52	293	5020	156	5.73	471	1810	192	5.61	503	9310	138	5.44	508	3970	420	5.92
Hexa	237	7820	200	5.93	22.4	3580	112	6.70	132	1150	122	5.97	117	6580	97.8	5.92	104	2070	219	6.32
Hepta	61.2	4060	104	6.23	19.8	1870	58.2	6.47	12.9	730	77.3	6.78	19.3	3490	51.9	6.43	25.5	1130	120	6.67
Octa	11.8	1230	31.5	6.43	4.05	564	17.6	6.64	3.69	225	23.9	6.81	N/A	1110	16.5	N/A	2.07	382	40.4	7.29
Nona + Deca	4.11	427	10.9	6.42	N/A	223	6.95	N/A	N/A	82.6	8.74	N/A	N/A	501	7.45	N/A	1.40	128	13.6	6.99
Total PCB	7010	39700	1020	N/A	4050	20200	629	N/A	3292	7504	794	N/A	4410	41000	610	N/A	3560	12700	1350	N/A

STATION: PAS2 (RM 8.44)

Sampling Date	12/15/00				03/15/01				10/19/01				03/12/02			
PCB Homologue	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]
Mono + Di	250	307	6.54	4.42	130	89.6	25.2	5.29	1020	895	28.1	4.44	502	N/A	N/A	N/A
Tri	1370	1570	33.4	4.39	949	434	122	5.11	3780	4530	143	4.58	2230	N/A	N/A	N/A
Tetra	1230	3790	80.7	4.82	737	1070	300	5.61	3170	9320	293	4.97	1790	N/A	N/A	N/A
Penta	316	2450	52.2	5.22	283	1010	283	6.00	1030	6720	211	5.31	764	N/A	N/A	N/A
Hexa	31.9	2290	48.7	6.18	31.5	746	210	6.82	400	5570	175	5.64	192	N/A	N/A	N/A
Hepta	25.6	1150	24.4	5.98	N/A	405	114	N/A	138	2890	90.9	5.82	52.6	N/A	N/A	N/A
Octa	N/A	327	6.95	N/A	N/A	128	35.9	N/A	38.4	980	30.8	5.90	8.33	N/A	N/A	N/A
Nona + Deca	N/A	125	2.67	N/A	N/A	51.8	14.6	N/A	11.8	337	10.6	5.96	0.00	N/A	N/A	N/A
Total PCB	3220	12000	256	N/A	2130	3930	1110	N/A	9580	31200	982	N/A	5540	N/A	N/A	N/A

STATION: PAS3 (RM 12.45)

Sampling Date	12/15/00				03/15/01				10/19/01				03/12/02			
PCB Homologue	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]
Mono + Di	227	138	59.6	5.42	101	4.11	2.30	4.36	608	893	23.2	4.58	775	362	20.4	4.42
Tri	421	387	167	5.60	534	31.2	17.5	4.51	2645	5170	134	4.71	3040	2150	121	4.60
Tetra	223	667	287	6.11	507	96.3	53.9	5.03	2347	10000	261	5.05	2580	3870	218	4.93
Penta	57.4	907	391	6.83	217	78.4	43.9	5.31	737	7540	196	5.42	1230	4460	251	5.31
Hexa	10.3	590	254	7.39	27.9	55.4	31.0	6.05	232	6210	161	5.84	277	2050	115	5.62
Hepta	5.38	316	136	7.40	N/A	23.1	12.9	N/A	52.0	3130	81.3	6.19	74.3	1150	64.7	5.94
Octa	N/A	22.2	9.56	N/A	N/A	7.23	4.05	N/A	4.10	1030	26.7	6.81	6.09	382	21.5	6.55
Nona + Deca	N/A	31.3	13.5	N/A	N/A	3.86	2.16	N/A	N/A	362	9.42	N/A	N/A	130	7.33	N/A
Total PCB	944	3060	1320	N/A	1390	300	168	N/A	6630	34400	893	N/A	7970	14500	819	N/A

Malcolm Pirnie Water Column Compilation
Distribution Coefficients (K_D)

STATION: PR005 (RM 10.32)

Sampling Date	03/16/99				08/25/99				05/09/00				10/18/00			
PCB Homologue	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]
Mono + Di	590	264	23.1	4.59	1300	1540	48.8	4.58	550	263	25.5	4.67	3320	2400	53.8	4.21
Tri	663	720	63.2	4.98	6150	7510	238	4.59	1200	1140	111	4.97	2610	10400	235	4.95
Tetra	703	1510	132	5.27	5570	15000	478	4.93	1590	2480	241	5.18	2540	25100	565	5.35
Penta	238	1260	110	5.67	1870	11400	363	5.29	401	1500	145	5.56	768	19700	442	5.76
Hexa	87.7	942	82.6	5.97	592	7650	243	5.61	N/A	1550	150	N/A	349	15000	337	5.98
Hepta	14.0	496	43.5	6.49	165	3750	119	5.86	N/A	549	53.3	N/A	142	9210	207	6.16
Octa	2.58	170	14.9	6.76	36.7	1180	37.6	6.01	N/A	114	11.1	N/A	38.5	2800	63.0	6.21
Nona + Deca	N/A	52.7	4.62	N/A	N/A	434	13.8	N/A	N/A	N/A	N/A	N/A	N/A	976	21.9	N/A
Total PCB	2300	5410	474	N/A	15700	48600	1540	N/A	3730	7590	737	N/A	9770	85600	1920	N/A

STATION: PR006 (RM 0.69, Surface)

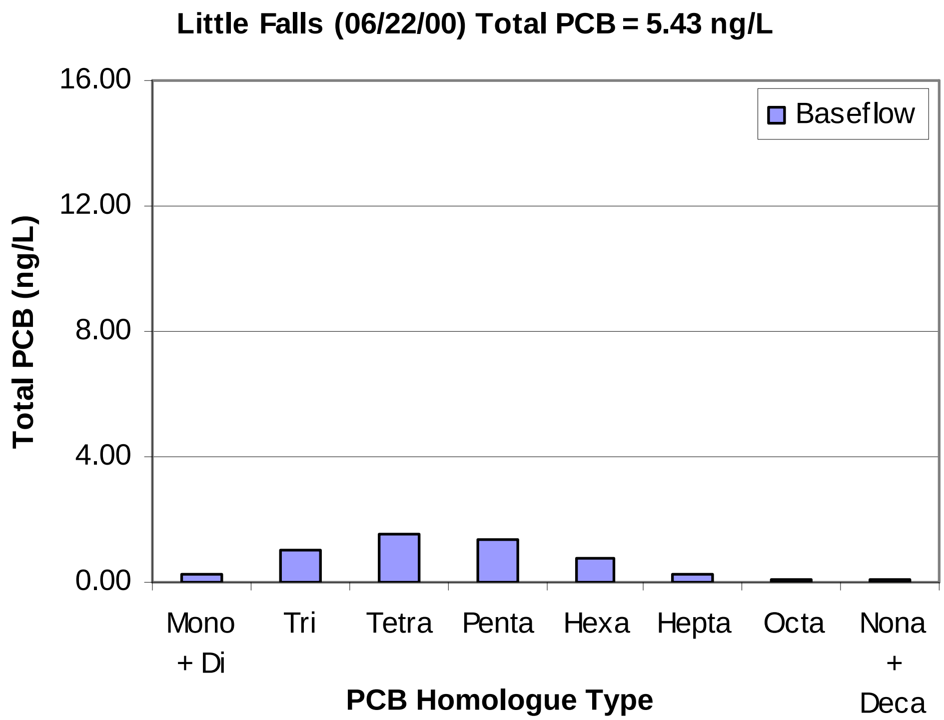
Sampling Date	11/13/98				02/03/99				06/17/99				06/27/00			
PCB Homologue	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]
Mono + Di	316	262	54.6	5.24	799	475	80.3	5.00	541	3883	162	5.48	670	N/A	N/A	N/A
Tri	2260	921	192	4.93	1860	1860	314	5.23	2890	13600	569	5.29	2270	N/A	N/A	N/A
Tetra	2500	2010	419	5.23	1680	2630	444	5.42	3680	21700	908	5.39	3940	N/A	N/A	N/A
Penta	487	1060	220	5.65	425	1990	336	5.90	1190	17200	721	5.78	719	N/A	N/A	N/A
Hexa	157	731	152	5.99	141	1910	323	6.36	389	12500	524	6.13	280	N/A	N/A	N/A
Hepta	28.1	333	69.4	6.39	27.3	1090	184	6.83	114	5980	250	6.34	65.0	N/A	N/A	N/A
Octa	1.72	74.3	15.5	6.95	N/A	354	59.8	N/A	42.4	2340	97.7	6.36	11.2	N/A	N/A	N/A
Nona + Deca	N/A	33.3	6.93	N/A	N/A	115	19.4	N/A	N/A	947	39.6	N/A	N/A	N/A	N/A	N/A
Total PCB	5750	5420	1130	N/A	4920	10400	1760	N/A	8850	78200	3270	N/A	7950	N/A	N/A	N/A

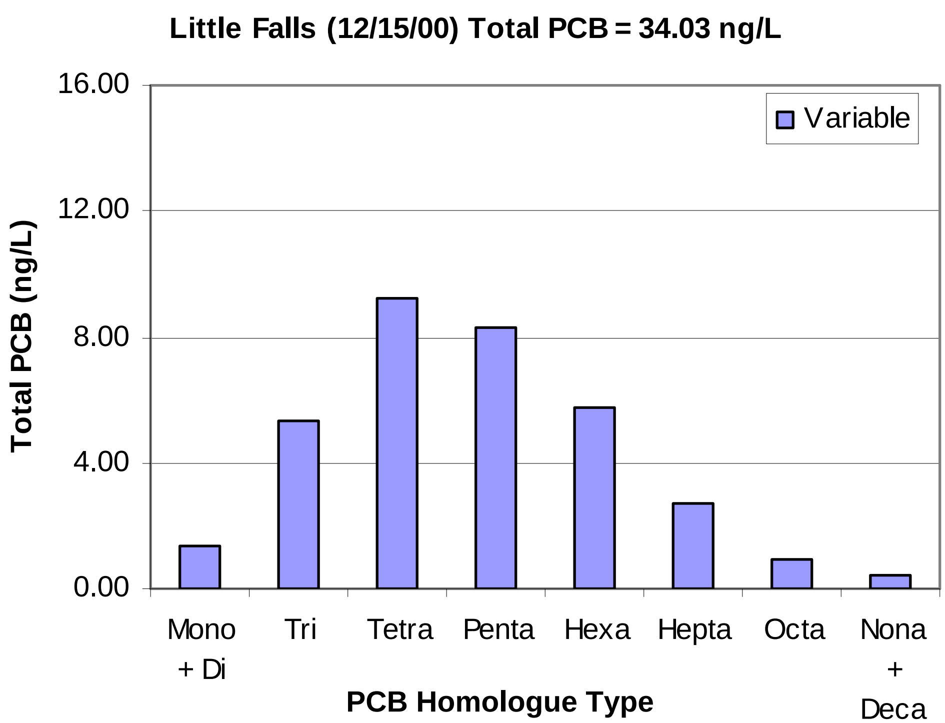
STATION: PR007 (RM 0.69, Bottom)

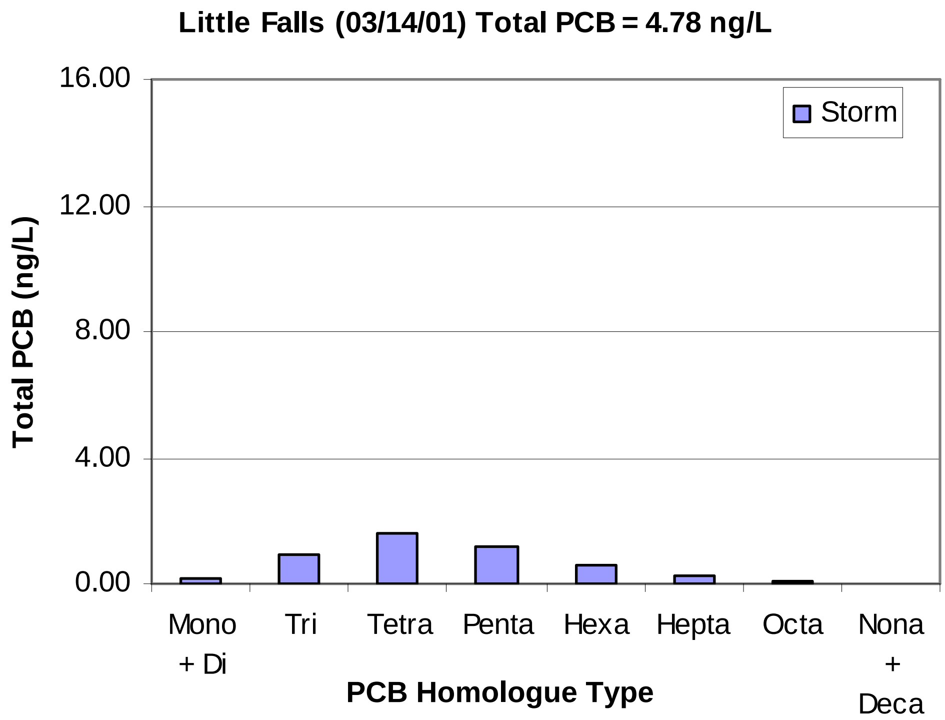
Sampling Date	02/05/99				07/21/99				05/02/00				06/26/00			
PCB Homologue	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]	Dissolved (pg/L)	Particulate (pg/L)	Particulate (pg/g)	Log [Kd (L/Kg)]
Mono + Di	1100	611	N/A	N/A	401	698	33.8	4.93	694	1070	20.2	4.46	589	N/A	N/A	N/A
Tri	1660	1920	N/A	N/A	2450	2650	128	4.72	2310	3990	75.8	4.52	2190	N/A	N/A	N/A
Tetra	1680	2320	N/A	N/A	2830	5740	278	4.99	3020	6890	131	4.64	3350	N/A	N/A	N/A
Penta	349	1570	N/A	N/A	1500	3940	191	5.11	769	4540	86.2	5.05	632	N/A	N/A	N/A
Hexa	130	1400	N/A	N/A	325	2400	116	5.55	N/A	4110	78.1	N/A	265	N/A	N/A	N/A
Hepta	19.7	694	N/A	N/A	78.5	996	48.3	5.79	N/A	2340	44.5	N/A	81.7	N/A	N/A	N/A
Octa	N/A	250	N/A	N/A	17.5	313	15.2	5.94	N/A	659	12.5	N/A	14.1	N/A	N/A	N/A
Nona + Deca	N/A	97.4	N/A	N/A	N/A	107	5.17	N/A	N/A	0.00	0.00	N/A	N/A	N/A	N/A	N/A
Total PCB	4950	8860	N/A	N/A	7600	16800	816	N/A	6790	23600	448	N/A	7110	N/A	N/A	N/A

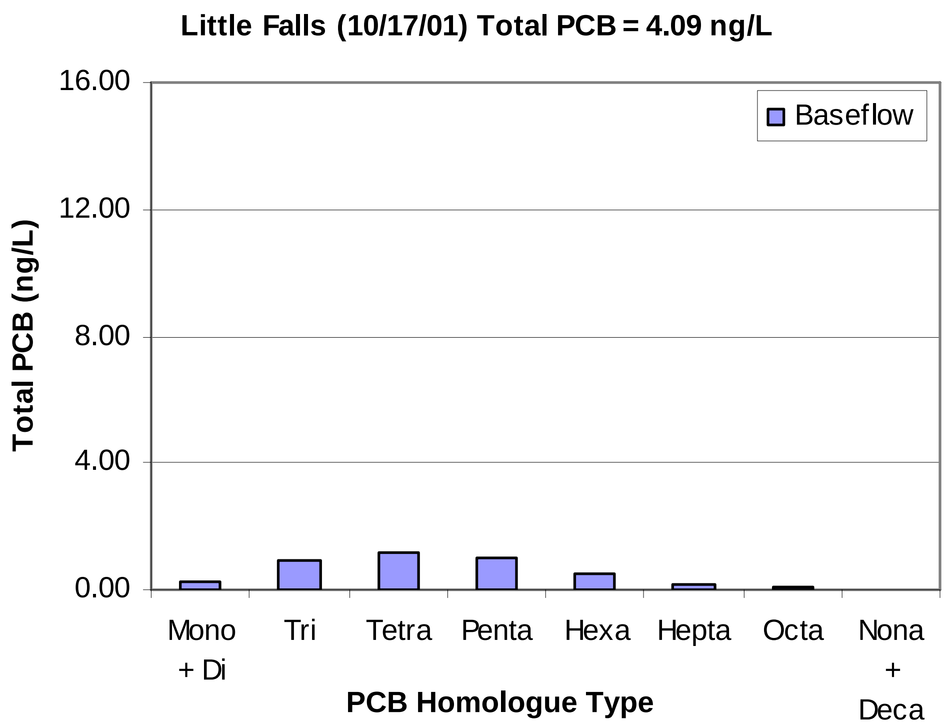
Notes:
N/A = Not applicable

Station ID: PASS (Little Falls)

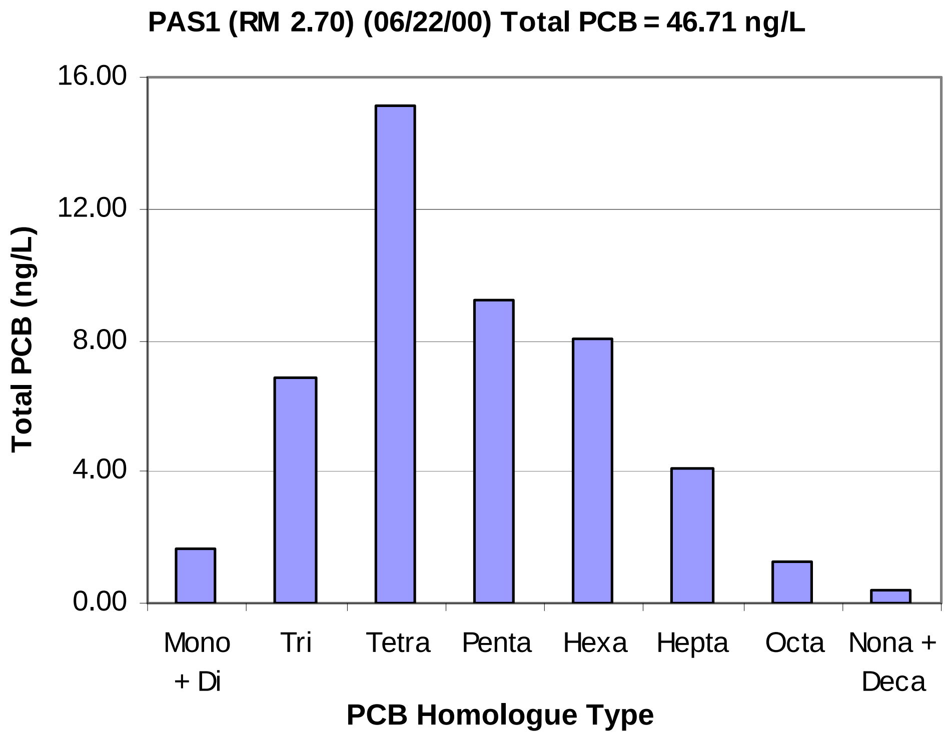


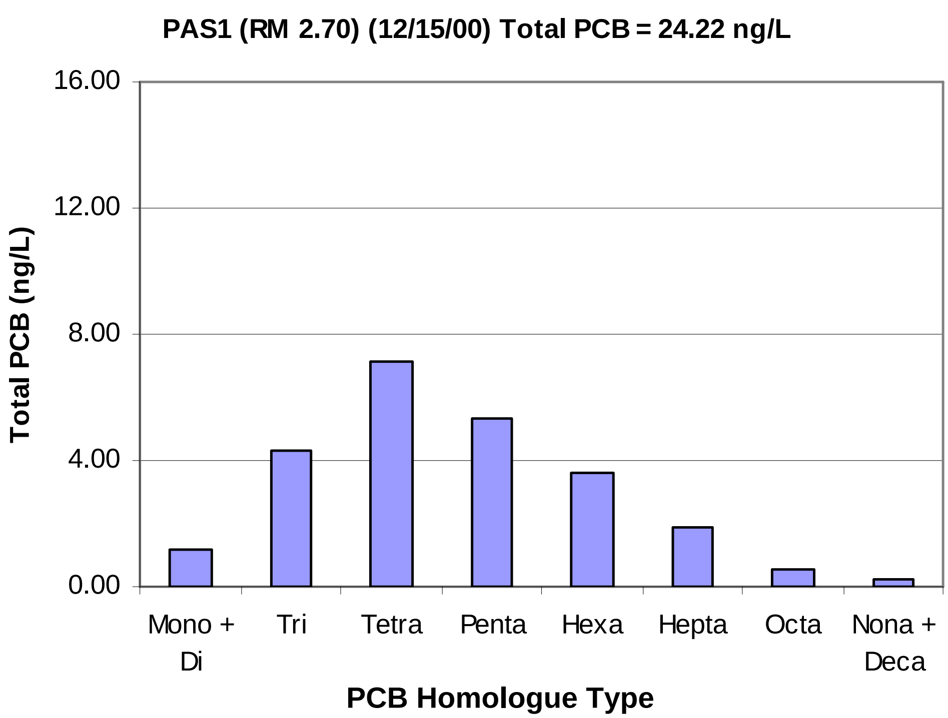


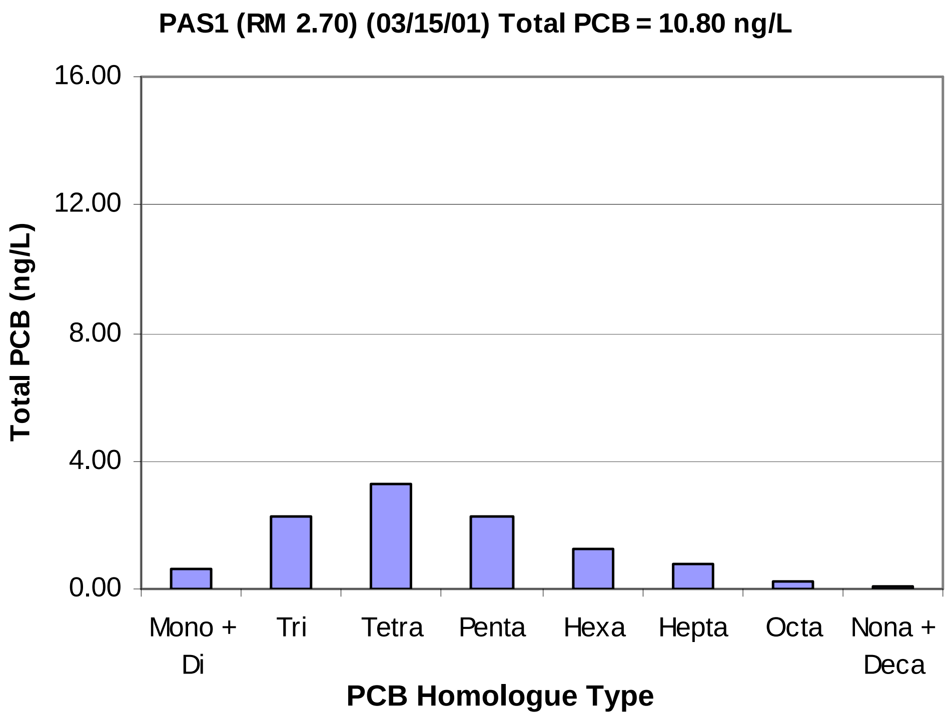

Little Falls (03/14/01) Total PCB = 4.78 ng/L
Storm
Total PCB (ng/L)
16.00
12.00
8.00
4.00
0.00
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

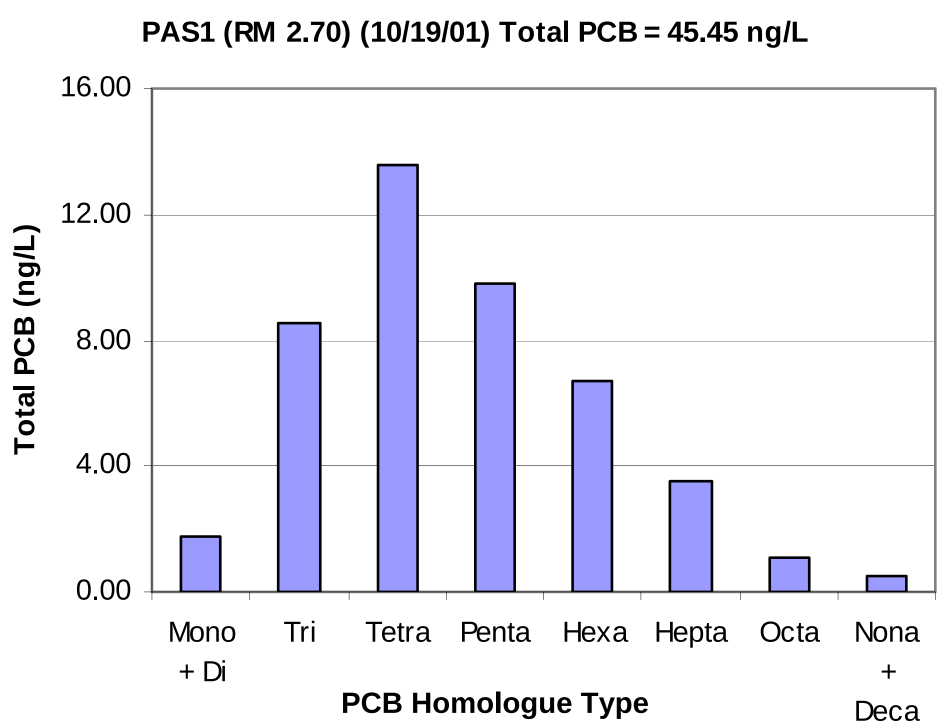

Little Falls (10/17/01) Total PCB = 4.09 ng/L
Baseflow
Total PCB (ng/L)
16.00
12.00
8.00
4.00
0.00
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

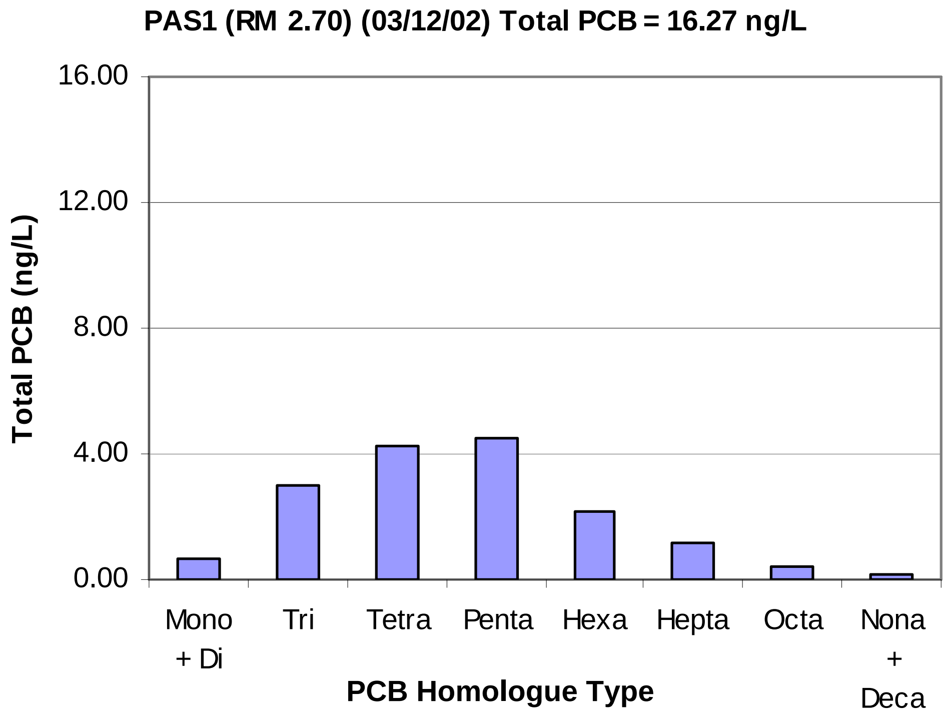
Station ID: PAS1 (RM 2.70)





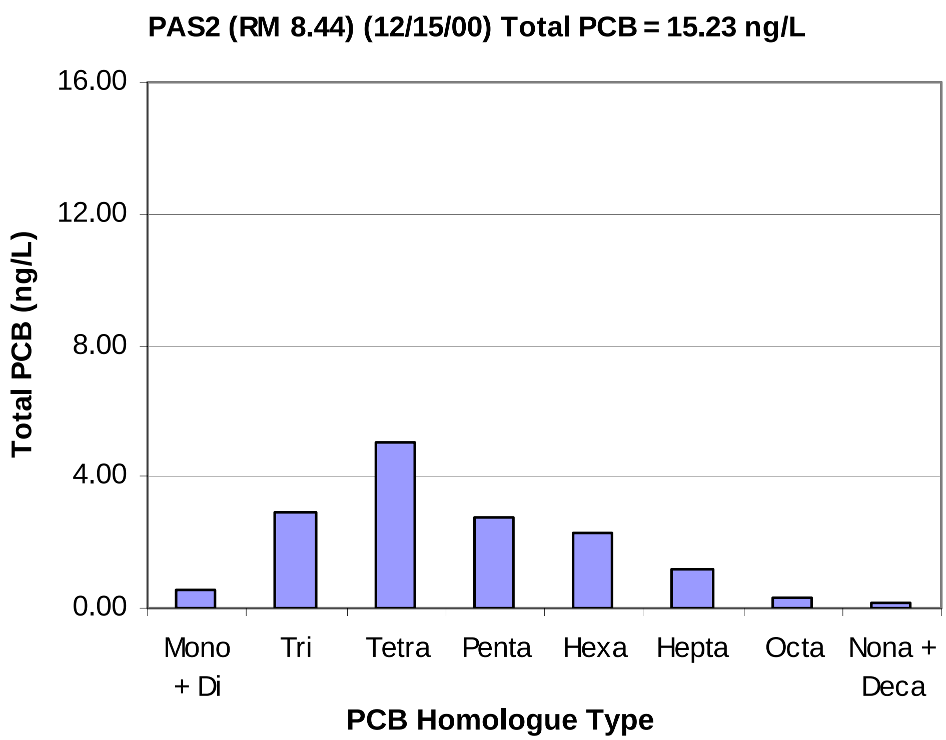

PAS1 (RM 2.70) (03/15/01) Total PCB = 10.80 ng/L
Total PCB (ng/L)
16.00
12.00
8.00
4.00
0.00
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

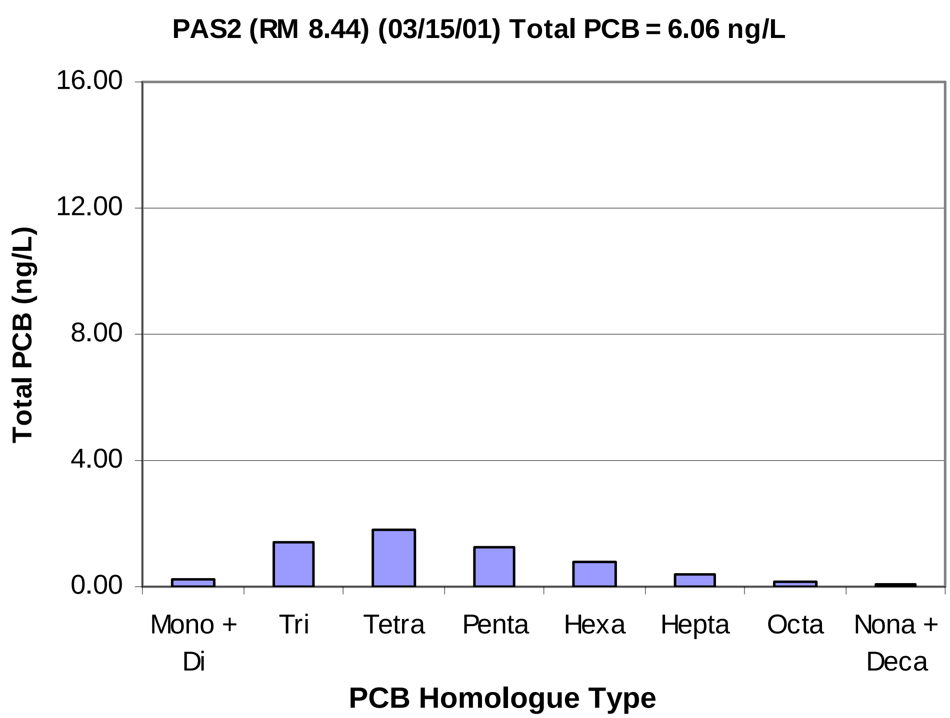

PAS1 (RM 2.70) (10/19/01) Total PCB = 45.45 ng/L
Total PCB (ng/L)
16.00
12.00
8.00
4.00
0.00
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

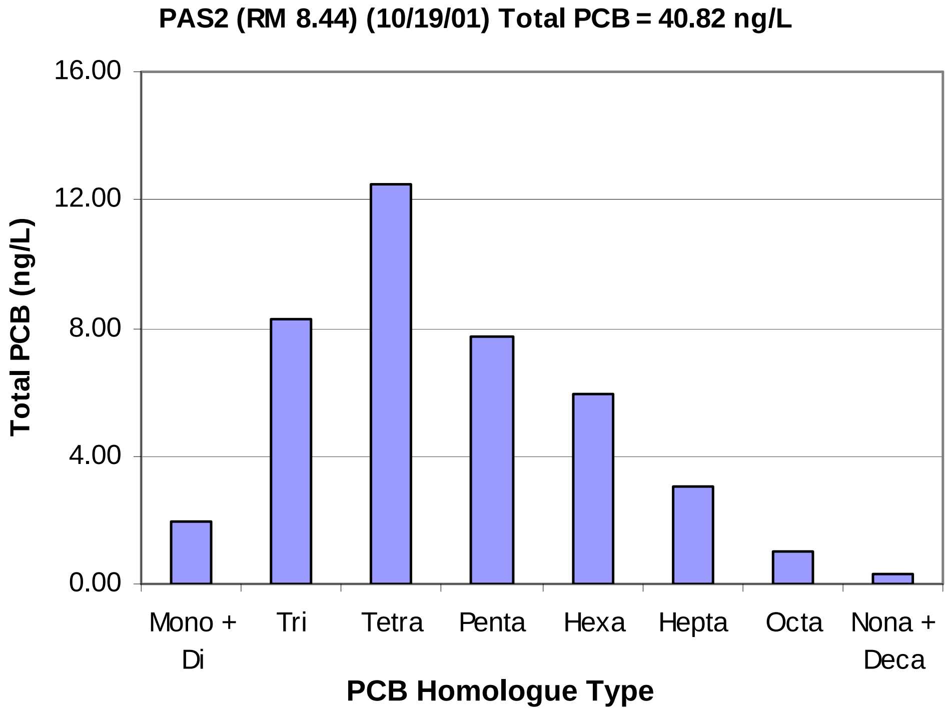

PAS1 (RM 2.70) (03/12/02) Total PCB = 16.27 ng/L
16.00
12.00
8.00
4.00
0.00
Total PCB (ng/L)
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

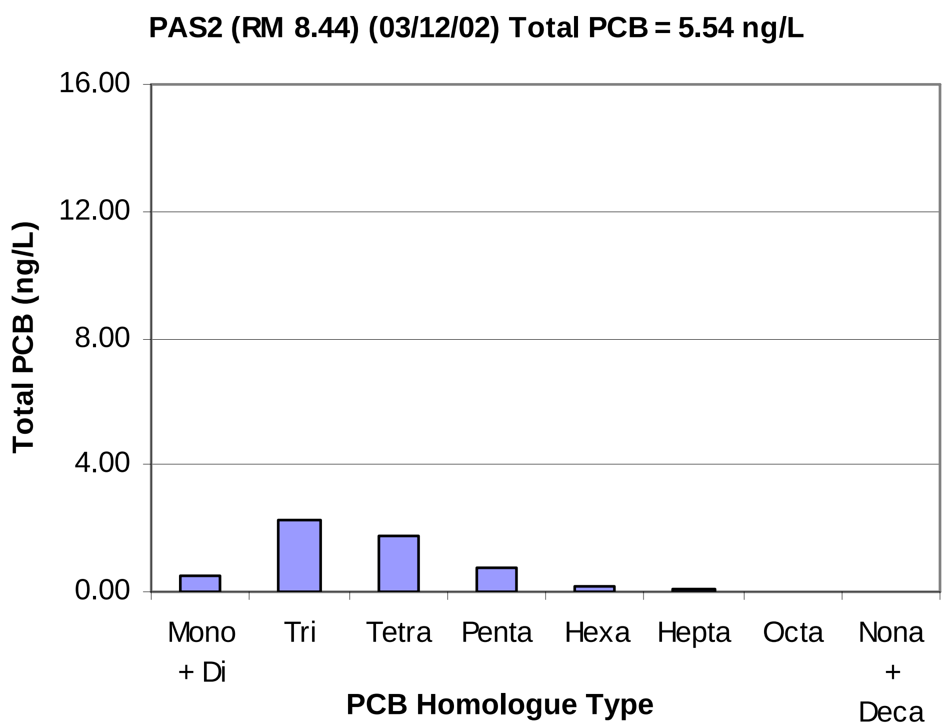
Malcolm Pirnie Water Column Compilation
PCB Homologue Profiles

Station ID: PAS2 (RM 8.44)

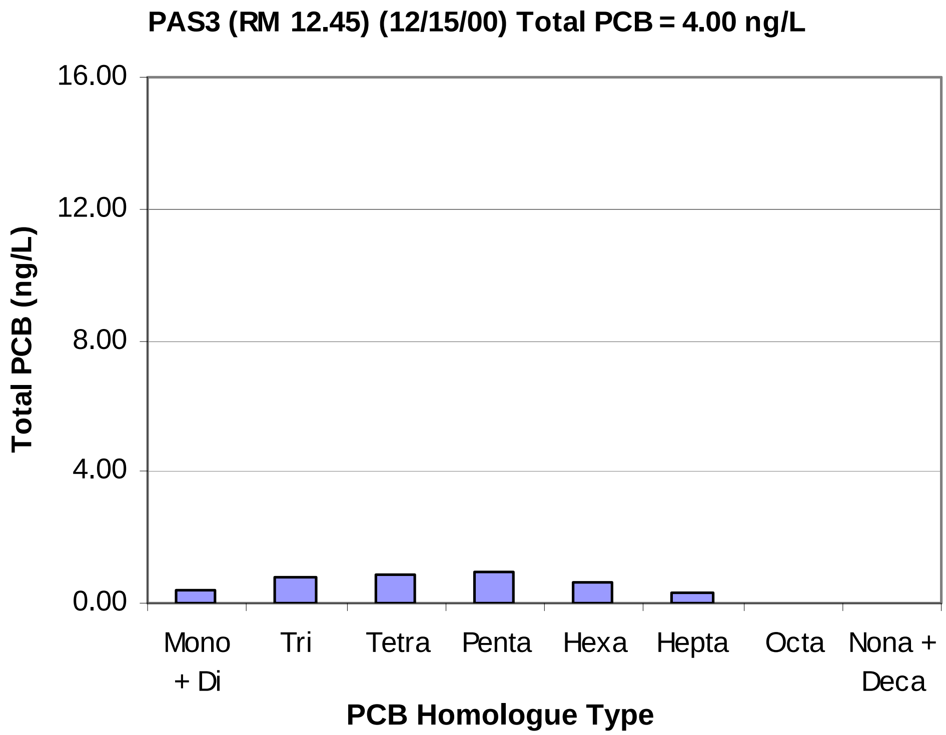


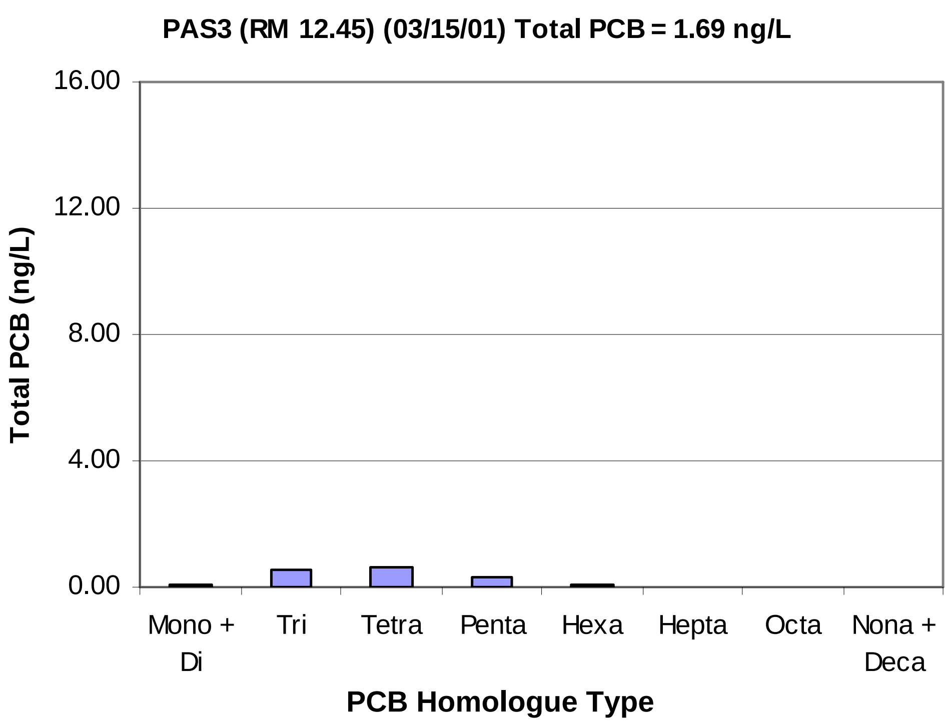


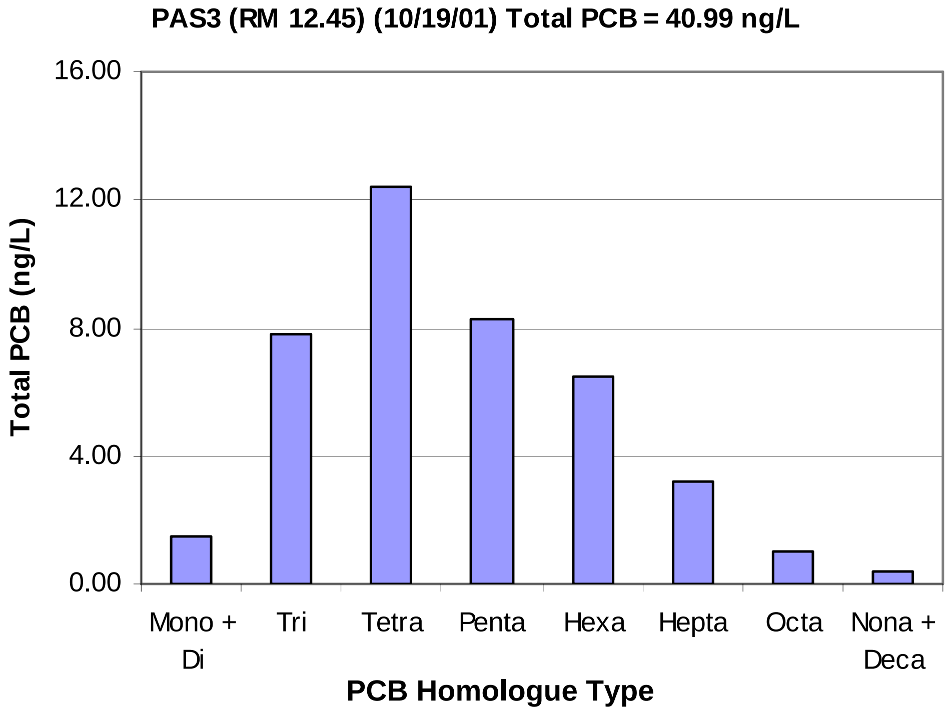

PAS2 (RM 8.44) (10/19/01) Total PCB = 40.82 ng/L
16.00
12.00
8.00
4.00
0.00
Total PCB (ng/L)
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

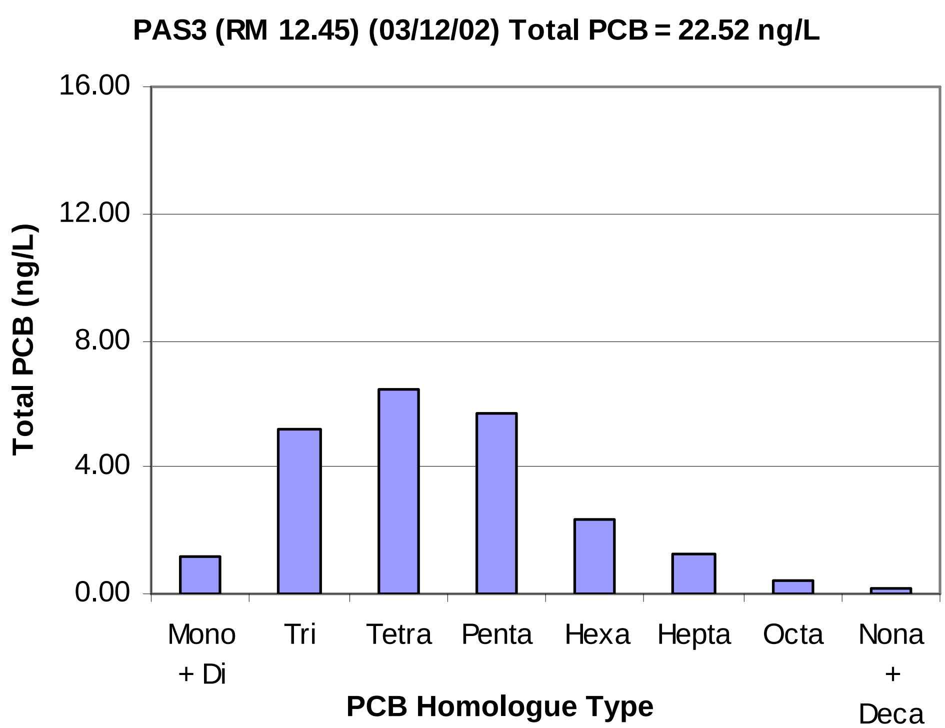

PAS2 (RM 8.44) (03/12/02) Total PCB = 5.54 ng/L
16.00
12.00
8.00
4.00
0.00
Total PCB (ng/L)
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

Station ID: PAS3 (RM 12.45)



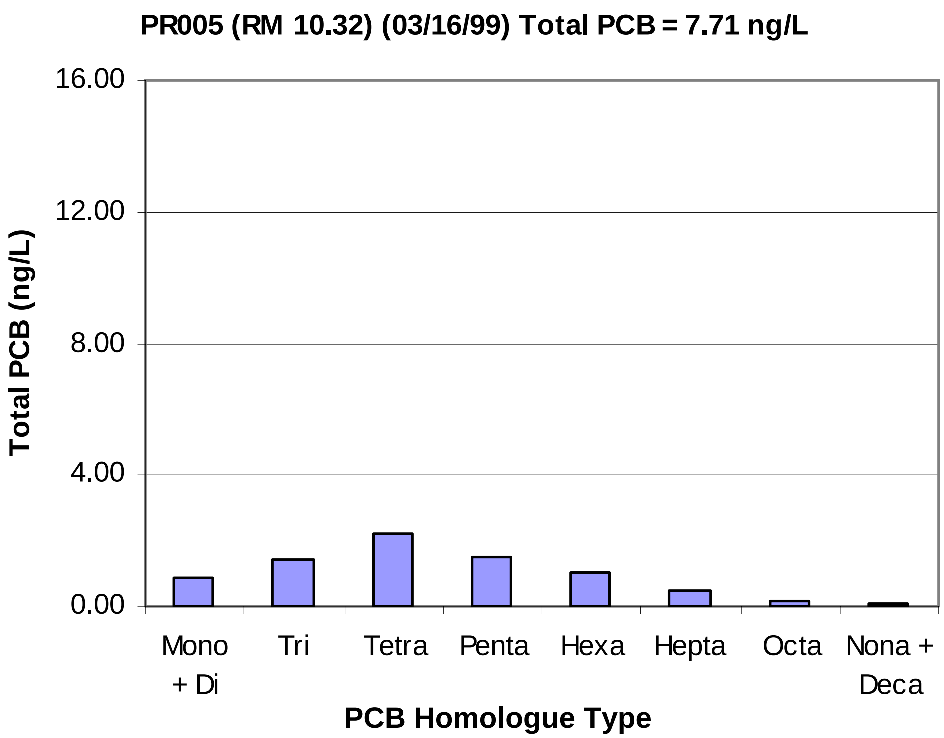


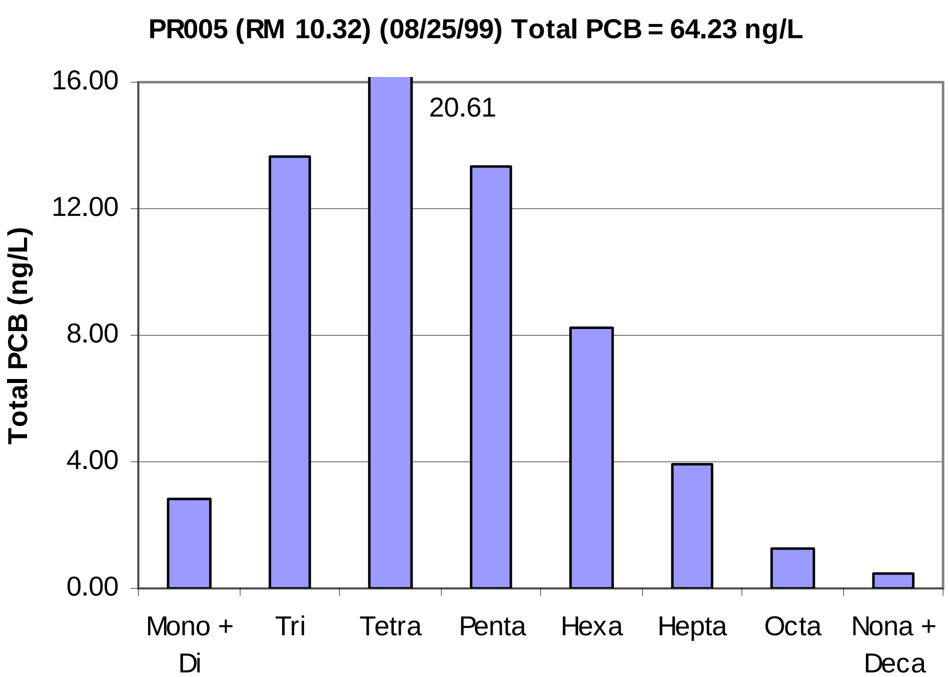

PAS3 (RM 12.45) (10/19/01) Total PCB = 40.99 ng/L
16.00
12.00
8.00
4.00
0.00
Total PCB (ng/L)
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

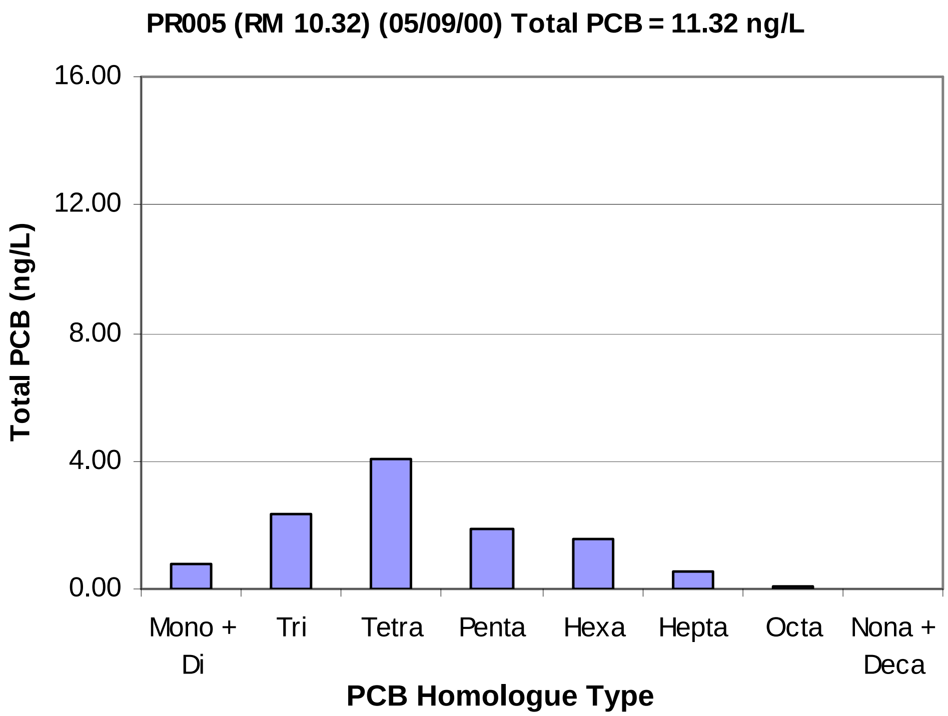

PAS3 (RM 12.45) (03/12/02) Total PCB = 22.52 ng/L
16.00
12.00
8.00
4.00
0.00
Total PCB (ng/L)
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

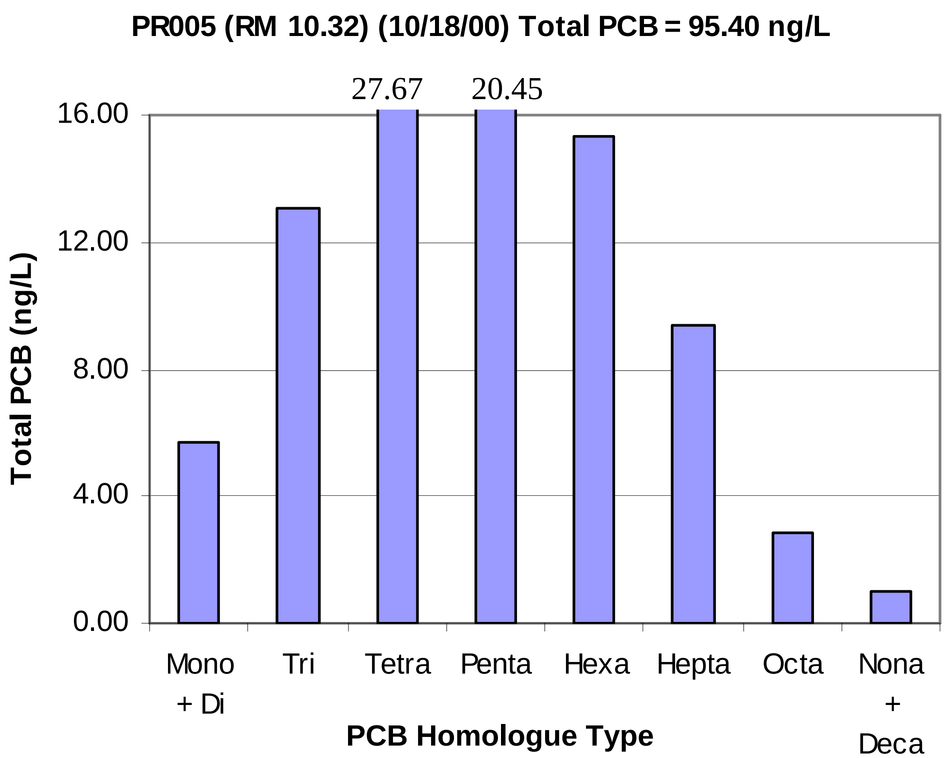
Malcolm Pirnie Water Column Compilation
PCB Homologue Profiles

Station ID: PR005 (RM 10.32)



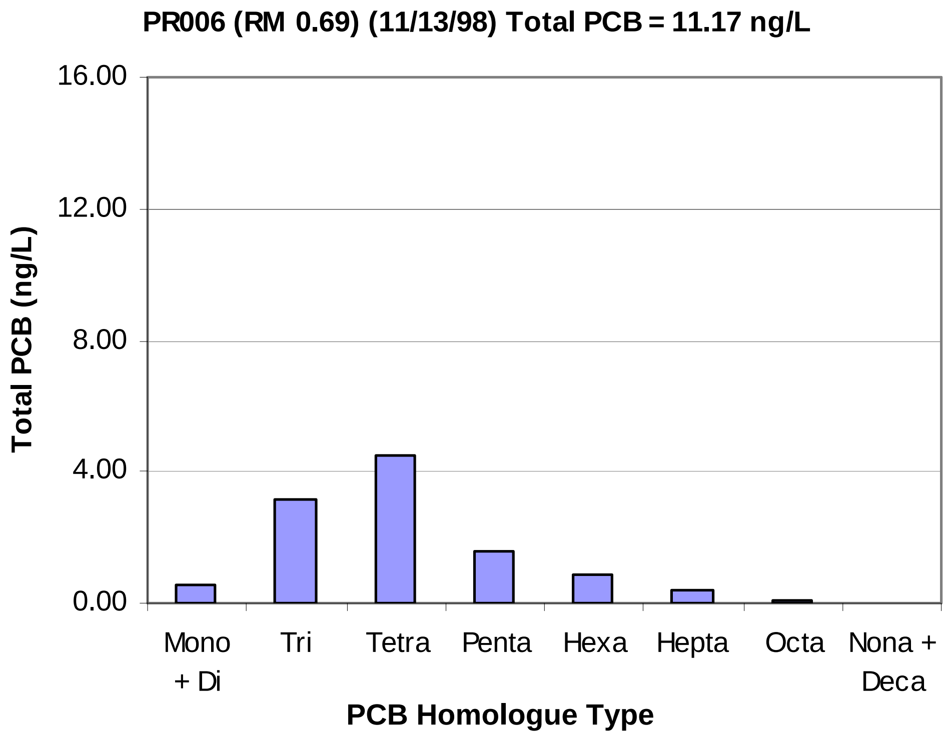


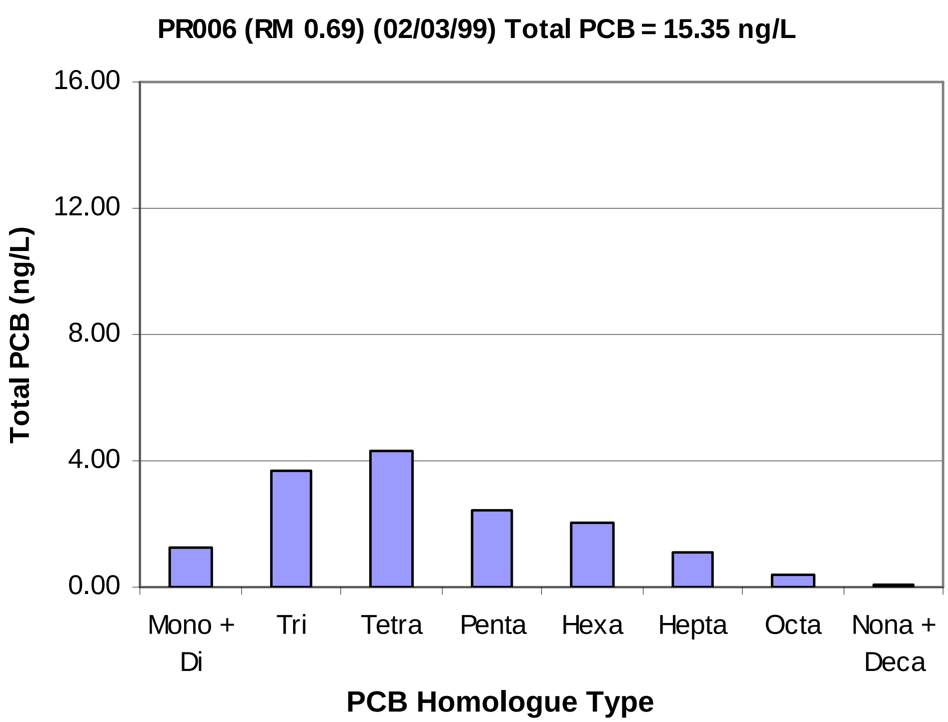

PR005 (RM 10.32) (05/09/00) Total PCB = 11.32 ng/L
Total PCB (ng/L)
16.00
12.00
8.00
4.00
0.00
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

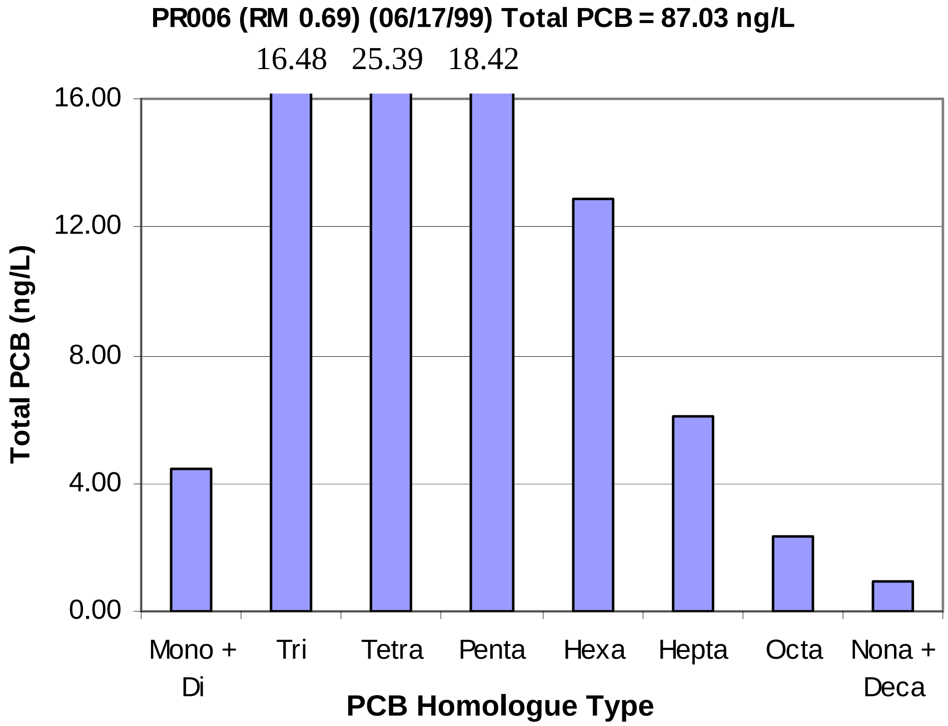

PR005 (RM 10.32) (10/18/00) Total PCB = 95.40 ng/L
27.67
20.45
Total PCB (ng/L)
16.00
12.00
8.00
4.00
0.00
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

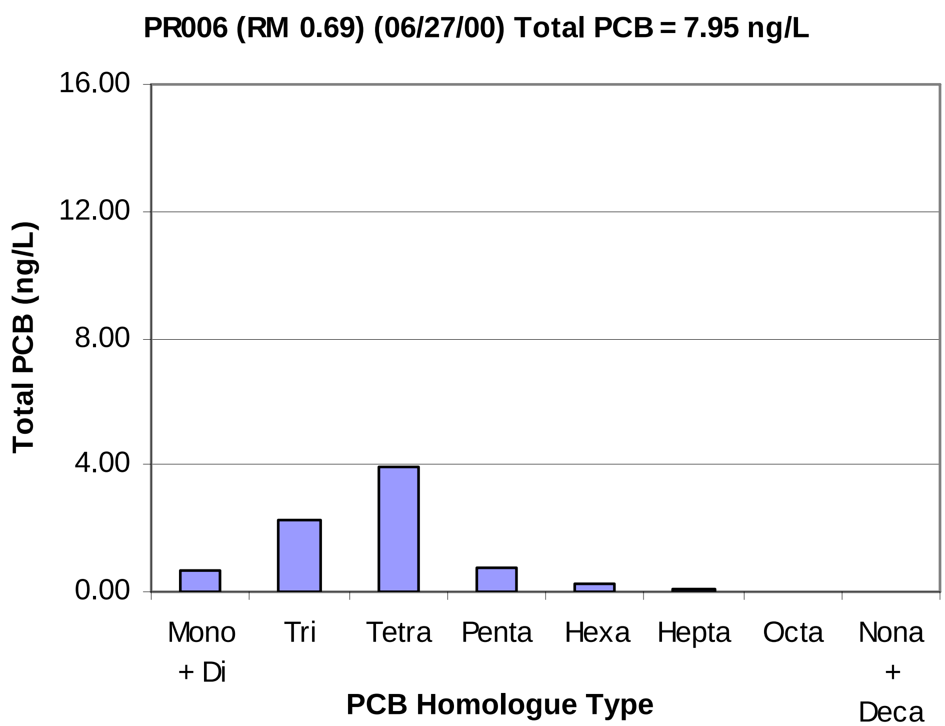
Malcolm Pirnie Water Column Compilation
PCB Homologue Profiles

Station ID: PR006 (RM 0.69, Surface)

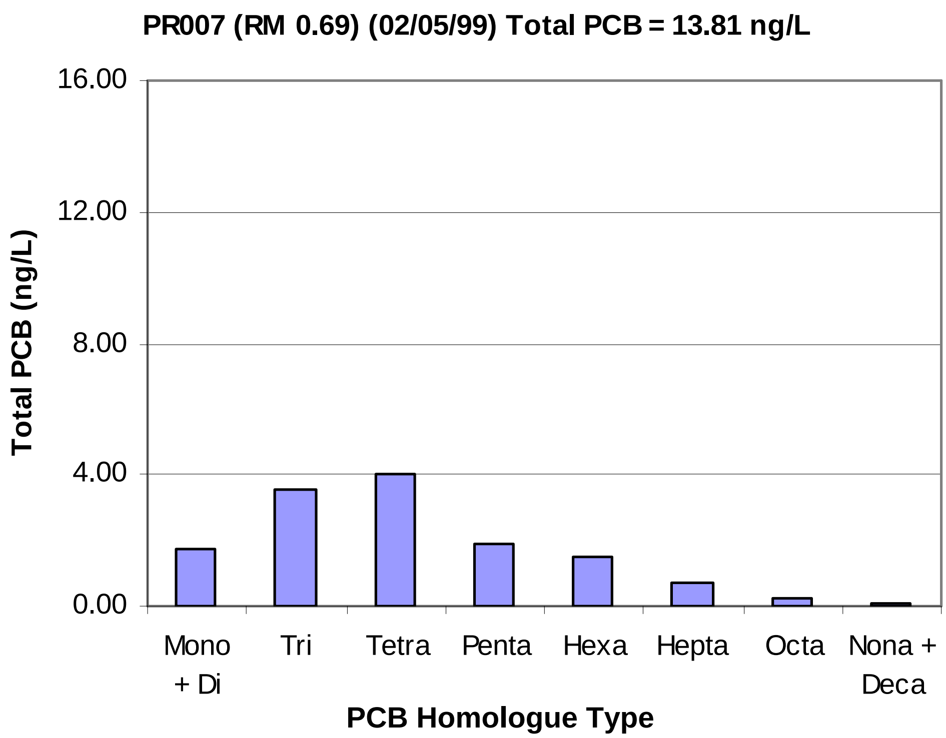


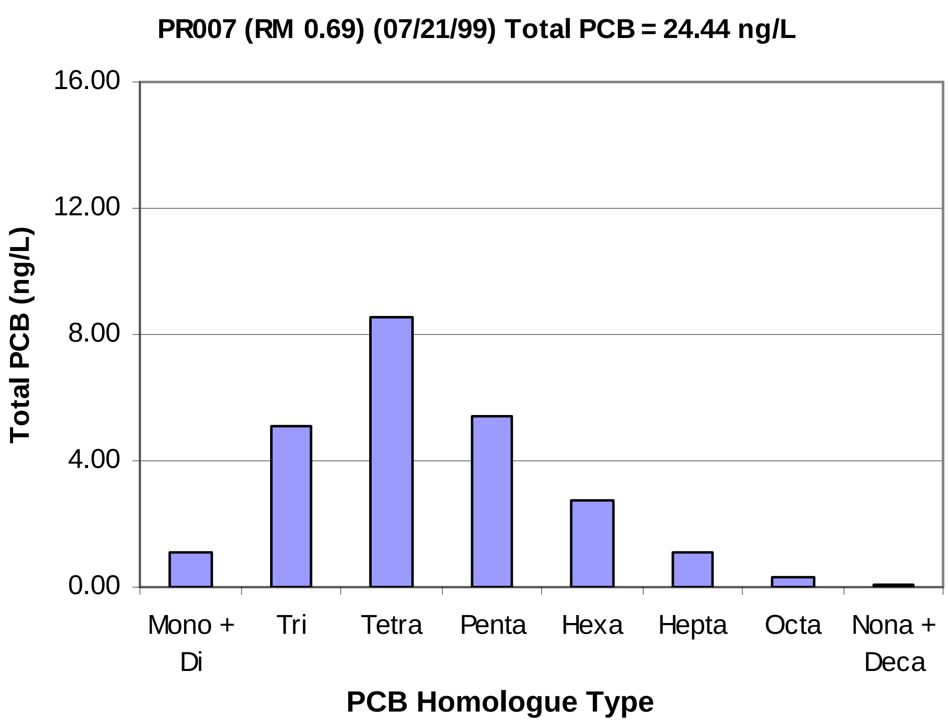


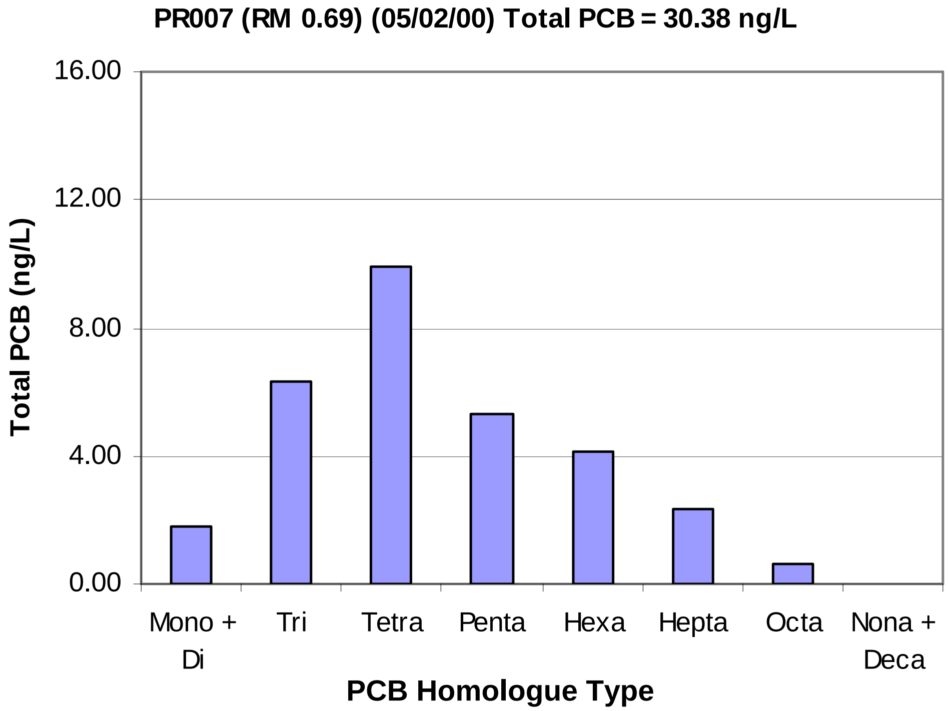

PR006 (RM 0.69) (06/17/99) Total PCB = 87.03 ng/L
16.48
25.39
18.42
16.00
12.00
8.00
4.00
0.00
Total PCB (ng/L)
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

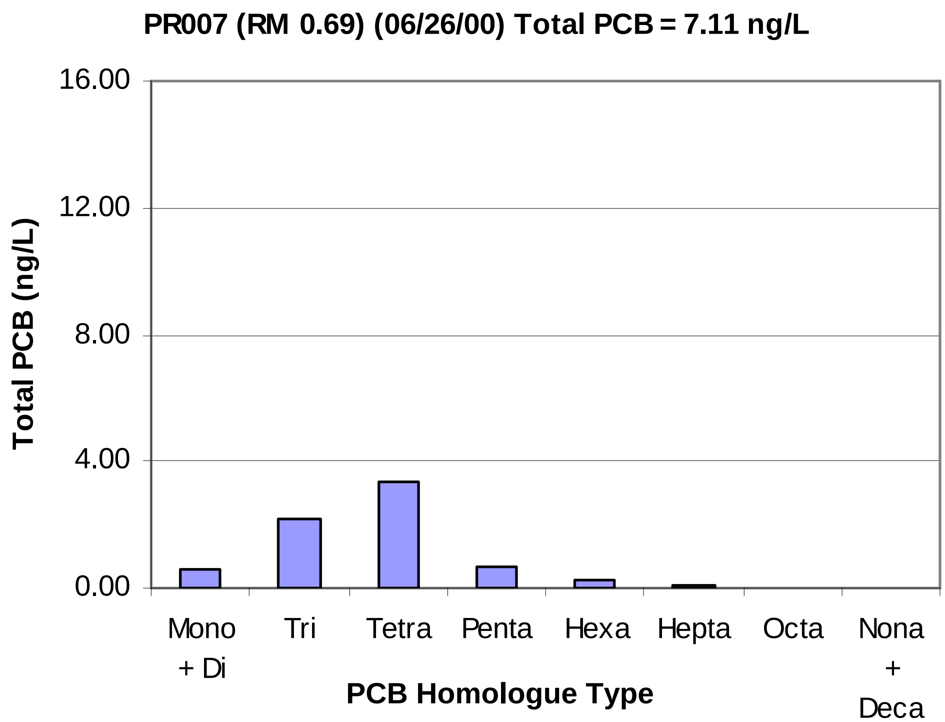

PR006 (RM 0.69) (06/27/00) Total PCB = 7.95 ng/L
16.00
12.00
8.00
4.00
0.00
Total PCB (ng/L)
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

Station ID: PR007 (RM 0.69, Bottom)






PR007 (RM 0.69) (05/02/00) Total PCB = 30.38 ng/L
Total PCB (ng/L)
16.00
12.00
8.00
4.00
0.00
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type


PR007 (RM 0.69) (06/26/00) Total PCB = 7.11 ng/L
Total PCB (ng/L)
16.00
12.00
8.00
4.00
0.00
Mono + Di
Tri
Tetra
Penta
Hexa
Hepta
Octa
Nona + Deca
PCB Homologue Type

Attachment 8: Water Column Methodology Summaries

Summaries completed by Malcolm Pirnie, Inc. evaluating water column sampling techniques and potential sampling locations. Note that all material presented in Attachment 8 is considered *preliminary*; refer to Section 6.0 of the Field Sampling Plan Volume 1 (Malcolm Pirnie, Inc., 2005b) for final description of the water column program and applicable standard operating procedures.

Dr. Jeffrey W. Talley, P.E.
Associate, Malcolm Pirnie

Water Column Sampling for the Lower Passaic River Restoration Project

A Discussion of Sampling Methodologies for Chemicals of Concern

Problem

The chemicals of concern (COCs) in the Passaic River system are numerous; those with the most restrictive regulatory cleanup requirements (parts per billion and in some cases parts per trillion) can be categorized into two general groups: (1) hydrophobic organic compounds (HOCs) (dioxins, PCBs, PAHs, etc.) and organometals (*i.e.*, methyl-mercury). The behavior of these chemicals in aquatic systems is very complex and influenced by a number of environmental variables including, but not limited to, pH, temperature, redox conditions, nutrient availability, biological activity, and the presence of inorganic and organic ligands. These factors can impact speciation (*i.e.*, mercury), distribution between sediment and water phases (*i.e.*, HOCs, mercury), and cycling between inorganic and organic forms (*i.e.*, mercury). In addition, the biogeochemical behavior of HOCs and organometals can be similar in the environment, resulting in strong sorption to solid surfaces, the formation of very stable complexes with organic matter, and bioaccumulation in the food chain.

Water column samples are needed to appropriately characterize the hydrodynamic and hydrologic factors that affect the distribution of these chemicals of potential concern (COPCs) and chemicals of potential ecological concern (COPECs) in the Passaic River system. Critical to determining the appropriate methods for the collection and associated analyses is understanding if the COCs in the collected samples are at spatial and temporal equilibrium. If they are at equilibrium, then it may be acceptable to adopt the less expensive technique of collecting the samples in the field and transporting them to the laboratory for further preparation, extraction, and analysis. However, if the distribution of these chemicals is not at equilibrium, mass transfer of chemicals from one phase to another (*i.e.*, dissolved HOCs sorbing to solids present in the water sample) can quickly occur. In this case, sample preparation in the field (*i.e.*, filtering of solids) is required, *significantly* increasing the associated costs.

Sampling Methodologies to Consider

A thorough analysis of “best practices” for water column sampling indicates three sampling methodologies offer scientific defensibility at reasonable costs; the Infiltrex 300, Niskin Bottles/20L Stainless Steel Pop Containers, and Semi-Permeable Membrane Devices (SPMDs). The Infiltrex 300 is an active high volume sampler (typically up to 100 L/sampling event) available from Axys Technologies. It can operate from any water sampling platform and removes solids and HOCs/organometals from the water samples (in the field) through the use of filters and XAD traps. Although XAD trap breakthroughs can occur for samples over 20-30L, XAD traps can be installed in series and analyzed separately to accommodate this factor. Most likely, a dedicated Infiltrex 300 would be needed for each sampling platform. Although each unit costs $16K, they can be rented for $3K/month. The filters and the XAD resin are relatively inexpensive. The Infiltrex 300 has been used for many years in multiple river systems (*i.e.*, Ohio River) similar in complexity to the Passaic River with great success. It is the preferred system for water column sampling when field filtering is necessary.

Niskin bottles (10L) are weighted-water-collection devices with triggered caps that can open at a predetermined depth in the water column. They can be easily used to collect water samples across transects of the river channel provided no field sample preparation is required. Generally, a composite of multiple samples is transferred into a 20L stainless steel pop container, which is transported in a cooler with ice to the analytical laboratory. Niskin bottles, in conjunction with stainless steel pop containers, have been used with great success (*i.e.*, Delaware River Basin Commission program) when field filtering and sample preparation is not required. However, Niskin bottles can be used in combination with the Infiltrex 300 if field sample preparation becomes necessary. A Niskin/20L stainless steel pop bottle collection system for one sampling platform would cost less than $1K.

Semi-Permeable Membrane Devices (SPMDs) are passive water column sampling units that are deployed for days to months. They estimate dissolved phase contamination based on lab-determined partitioning coefficients and sampling rates. SPMDs consist of a tubular lay-flat, low-density polyethylene (LDPE) membrane containing a thin film of a high-molecular weight lipid (triolein). When placed in an aquatic environment, SPMDs accumulate HOCs and organochlorine pesticides. The LDPE tubing mimics a biological membrane by allowing selective diffusion of organic compounds. The passive sampling of the HOCs is driven by membrane- and lipid-water partitioning. SPMDs provide estimated time-weighted average chemical concentrations, but their data can also be used to estimate bioconcentration factors. SPMDs have been used successfully in the Columbia River for monitoring HOCs. A SPMD system for one sampling platform would costs less than $1K.

Recommendation

Conduct a field validation test of the Infiltrex 300, Niskin Bottles/20L Stainless Steel Pop Containers, and Semi-Permeable Membrane Devices (SPMDs) under multiple conditions, locations, and depths in the Lower Passaic River. The field test could determine if COC phase distribution changes over time and under varying environmental conditions. This would provide the necessary data to validate if and/or when field sample preparation is needed. It is possible that different or combined sampling methodologies could be required at different sampling locations. This field test would serve to optimize the water column sampling process in terms of scientific excellence and cost reduction. Such a field test could be conducted quickly (weeks to months) and the savings associated with an optimized sampling and analysis approach could more than pay for the cost of the test.

Also recommend that Task 7, Fixed Transect Water Column Sampling , Lower Passaic Restoration Project Draft Field Sampling Plan, Volume 1 (April 2005) and its associated SOPs be revised to reflect the addition of a Field Validation Test for the following sampling methodologies: Infiltrex 300, Niskin Bottles/20L Stainless Steel Pop Containers, and Semi-Permeable Membrane Devices (SPMDs).

Preliminary Approach for Water Column Sampling of Chemicals of Potential Concern (COPCs) and Chemicals of Potential Ecological Concern (COPECs) in the Lower Passaic River

Background

As part of the Data Quality Objectives (DQO) process, four principal Remedial Investigation (RI) Feasibility Study (FS) questions need to be addressed:

1) What are the chemicals of potential concern (COPCs) and chemicals of potential ecological concern (COPECs)?

2) What is the extent and distribution of contaminants in sediment, surface water and biota? Have the source areas been identified? Are contaminants being exported from the Study Area? How could contaminant export be impacted by changing environmental conditions?

3) What are the quantitative human and ecological health risks posed by the contamination in the Study Area?

4) Are the human health and ecological risks posed by the Study Area unacceptable [*i.e.*, the risk range identified in the National Contingency Plan (NCP) is exceeded], and consequently, is assessment of remedial action warranted via a FS?

To appropriately address the above questions, field investigations are needed to provide:

- Baseline water column data on COPCs and COPECs for human health and ecological risk assessment.
- Baseline water column data on COPCs and COPECs for the development, calibration, and evaluation of fate and transport models.
- Baseline water quality data to support a remedial investigation designed to determine the nature and extent, source areas, and fate and transport of COPCs and COPECs.

The COPCs and COPECs in the Passaic River system can be categorized into three general groups: (1) hydrophobic organic compounds (HOCs) [*e.g.*, dioxins, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs)], (2) trace metals and (3) methyl-mercury. In addition to these COPCs and COPECs, several conventional [*e.g.*, Total Suspended Solids (TSS), particulate organic carbon (POC), dissolved organic carbon (DOC), particle size distribution, biochemical oxygen demand (BOD), chemical oxygen demand (COD), Kjeldahl nitrogen, chlorophyll A, total and orthophosphate, and ammonia] and hydrodynamic (*e.g.*, turbidity, current, temperature, water depth, salinity) parameters are needed to support fate and transport analysis, eutrophication modeling, and risk assessment.

The behavior of COPCs and COPECs in the Passaic River system is influenced by many environmental variables including, but not limited to: pH, temperature, reduction-oxidation conditions, nutrient availability, sediment transport, biological activity, and the presence of inorganic and organic ligands. These factors can impact speciation, distribution between sediment and water phases, and cycling between inorganic and organic forms. Additionally, both HOCs' and organometals' biogeochemical behavior can result in strong sorption to solid surfaces, formation of stable complexes with organic matter, and bioaccumulation in the food chain.

Because the fate and transport model developed for this project and the geochemical analysis required to update the geochemical components of the conceptual site model are driven by partitioning of contaminants between the dissolved and particulate phases, the long-term water column sampling program should emphasize the collection of both dissolved phase and particulate phase COPCs and COPECs, under different hydrodynamic and hydraulic conditions.

Several sampling methodologies for HOCs are needed because the concentrations of select HOCs (*i.e.*, dioxin), particularly in the dissolved phase, are very low (parts per billion and in some cases parts per trillion). Each of these methodologies has associated uncertainties and the quality of the data obtained may be affected by shifts in HOC partitioning, the adsorption of HOCs to walls of the sampling containers, and the degree of HOC recovery in resin traps.

In order to address the complexities associated with low-level HOC sampling and analysis, and provide initial baseline water quality data to assess current-day levels of other target constituents (*i.e.*, metals, conventionals) under varying hydrodynamic conditions, an initial sampling program is proposed. The objectives of this program are to:

1. Provide initial water column data on trace metals, methylmercury, and conventional parameters to update the CSM and calibrate the fate and transport model being developed for the restoration efforts. The sampling for trace metals, other than mercury, will use ultra-clean techniques in conformance with USEPA Method 1669. Sampling for mercury and methylmercury will use the ultra-clean aqueous sampling techniques provided by Frontier Geosciences Inc. (Seattle, Washington).

2. Conduct a HOC sampling methodology validation study for the project. This validation study will answer the following questions:

    - What are the uncertainties associated with each HOC sampling methodology and which methodology best serves the project goals?
    - What are the effects of HOC phase shifts due to holding times and adsorption to the walls of the sampling containers?

3. Analyze the initial results of the above two sampling objectives and design a comprehensive long-term sampling program that will satisfy the data needs of the project. It is envisioned that the long-term sampling program would be less broad and more focused than the short-term sampling program, once initial concentration patterns of COPCs and COPECs, as well as HOC sampling methodologies, are determined and validated.

Sampling Methodologies under Consideration for HOCs

A thorough analysis of "best practices" for water column sampling indicates three sampling methodologies offer scientific defensibility at reasonable costs: (1) intake pump/filtering system equipped with XAD resin trap or similar sampling devices [*e.g.*, Infiltrex 300, Trace Organics Pollution Sampling (TOPS)] for the collection of discrete filtered samples (organics); (2) Niskin Bottles/20L Stainless Steel "Pop" Containers for collection of large volume samples for low to trace HOCs; (3) Semi-Permeable Membrane Devices (SPMDs) for collecting time-weighted average dissolved HOC concentrations. These methods are briefly described below.

The Infiltrex 300 is a commercialized version of the TOPS and available from Axys Technologies. It can operate from any water sampling platform and removes solids and HOCs/organometals from water samples (in the field) through the use of filters and XAD traps. Although XAD trap solids breakthroughs can occur when collecting samples over 20-30L, XAD traps can be installed in series and analyzed separately to accommodate such samples. Most likely, a dedicated Infiltrex 300 would need to be maintained in a field sample processing facility or other controlled environment where power and other services (*i.e.*, anecdotal information indicates the Infiltrex is not robust enough to perform optimally on small boats). Although each unit costs approximately $16,000 they can be rented for approximately $3,000 per month. The filters and XAD resin are relatively inexpensive. The Infiltrex 300 has been used for many years in multiple river systems (*e.g.*, Ohio River) similar in complexity to the Passaic River with great success. It is the preferred system for water column sampling when field filtering is necessary.

Niskin bottles (10L) are weighted, water sample collection devices with triggered caps that can be remotely closed at a predetermined water column depth. They can be easily used to collect water samples across a river channel transect provided no field sample preparation is required. Generally, a composite of multiple samples is transferred into a 20L stainless steel pop container, which is transported in a cooler with ice to the analytical laboratory. Niskin bottles, in conjunction with stainless steel pop containers, have been used with great success (*e.g.*, Delaware River Basin Commission program) when field filtering and sample preparation are not required.

SPMDs are passive water column sampling units that are deployed for days to months. They estimate dissolved phase contamination based on lab-determined partitioning coefficients and sampling rates. SPMDs consist of a tubular, lay-flat, low-density polyethylene (LDPE) membrane containing a thin film of a high-molecular weight lipid (triolein). When placed in an aquatic environment, SPMDs accumulate HOCs and organochlorine pesticides. The LDPE tubing mimics a biological membrane by allowing selective diffusion of organic compounds into the sampling device. The passive HOC sampling is driven by membrane- and lipid-water partitioning. SPMD is a useful technique for establishing temporally-averaged spatial trends in dissolved organic contaminants. Because it is a semi-quantitative technique, it does not provide direct measurements of concentration, but it can be used to compare the relative concentration among the stations (assuming turbulence, temperature, etc. is uniform). Biofouling is likely an issue, as is variable sampling rates in differing salinities and under differing flow conditions. SPMDs have been used successfully in the Columbia River for monitoring low-level HOCs.

Short-Term Water Column Sampling Approach

To satisfy the objectives of the short-term water column program, an initial monitoring program over a 2-3 month period is proposed. The program will involve conducting sampling at: i) 2 stations in the tidal river, at river mile 2.5 (the salt-wedge station) and river mile 10.5 (a freshwater station), ii) river mile 17 at the Ackerman Bridge, close to the head of tide and the Dundee dam boundary, and iii) at the head of tide of the major tributaries to the Lower Passaic River including the Saddle River, 2nd River, and 3rd River. Note that some of the proposed sampling will only be conducted at selected stations. Each sampling methodology will be implemented with a high degree of quality control including field blanks, replicates, and spikes. The analysis related to the HOC sampling methodology validation study will be performed by the same lab. The following is an overview describing the initial sampling program:

Time-Weighted Average (TWA) Samples

Semi-permeable membrane devices (SPMDs) will be placed at all stations identified above. At each location, SPMDs will be placed approximately 2 feet below the water surface. Additional SPMDs will be placed approximately 2 feet above the river bottom at river mile 2.5 to capture the stratification effects of the salt or brackish water. After 28 days, SPMDs will be collected and replaced with fresh SPMDs. The retrieved SPMDs will be packaged and shipped to the specialty subcontractor for sample preparation and extraction; the extract analysis may be conducted at a separate subcontractor laboratory. SPMDs will be used to estimate time-weight-averaged concentrations and bioconcentrations of trace HOCs such as PCBs, PAHs, dioxins, and pesticides. The SPMD data will be used to screen for the presence of certain HOCs in the tributaries and to compare the relative fingerprints of the HOCs in the different locations. Note that the SPMDs will not be used in the HOC sampling methodology validation study.

Small-Volume Composite Grab (SVCG) Samples for Baseline Metals/Conventional Parameters

Small volume (1-5 liters) water column composite grab samples will be collected for TAL metals, mercury and methylmercury, and conventional and eutrophication model parameters [TSS, POC, DOC, particle size distribution, BOD, COD, Kjeldahl Nitrogen, Chlorophyll A, total and orthophosphate, ammonia, pH, dissolved oxygen (DO), and secchi disk] at the two stations in the tidal river and at the head of tide station at the Ackerman Bridge. This sampling will be conducted after the SPMDs have been deployed. Samples will be collected at the same time at each station, and the tidal stage and hydrodynamic conditions of the river will be noted. Samples will be collected at approximately 2 feet below the water surface, with an additional sample collected approximately 2 feet above the river bottom at river mile 2.5 to capture the stratification effects of the salt or brackish water. At each location, multiple grabs will be collected across a river transect consisting of three to five sites per transect. Samples will be composited to represent the cross-section, managed/preserved as required, and shipped to the lab on the day of collection.

HOC Sampling Methodology Validation Study (HSMVS)

The HOC Sampling Methodology Validation Study will be conducted after the SVCG sample collection, and only at the tidal river stations. The HSMVS will:

1. Use an Infiltrex 300 or similar large volume sampler to obtain dissolved and particulate phase samples.

2. Collect representative large volume samples (~20L) and filter them immediately in the field.

3. Collect large volume grab samples (whole water ~20L) using 10L Niskin bottles or similar clean sampling devices. The samples will be transferred on site to pre-cleaned stainless steel pop bottles, as previously used in the Delaware River Basin Program, and which will be immediately shipped to the lab for filtering and analysis.

The sampling for this study will be conducted during ebb tide during the first month and flood tide during the second month, under high and low particulate or river flow conditions to reflect different flow/particulate concentrations. Samples for all three validation study programs will be done at the same time over a two-day period. Sampling on the first day of the HSMVS program will be done at river mile 2.5, and on the second day sampling will be done at river mile 10.5. During each day of sampling a separate 5-liter whole water column sample will also be collected for analysis for TSS, POC and DOC and PAHs. Conventional and hydrodynamic parameters including: DO, conductivity, temperature, current, pH will be monitored during the sampling period.

Field Sampling Activities

A tentative timeline for baseline field sampling activities is presented in Table 1.

Table 1: Timeline for Initial Monthly Field Sampling Activities

Day	Task	Location	Depth	Sampling Time
Day 1	Deploy 3 SPMDs	In the vicinity of river miles (RM) 2.5, 10.5 and 17	At RM 2.5 near water surface and near river bottom.	SPMDs will be removed for analysis after 28 days
Day 2	Deploy 3 SPMDs	Head of tide for each major tributary (*i.e.*, 2nd River, 3rd River, and Saddle River)	Near surface of river/tributary.	SPMDs will be removed for analysis after 28 days.
Day 3	Collect SVCG samples for metals and conventional/ eutrophication parameters	RM 2.5, 10.5 and 17	Adjacent to all SPMDs.	1st month during Ebb tide/ 2nd month during flood tide. Note time of tidal stage.
Day 4	Collect HSMVS samples for PCBs, Dioxins/Furans, PAHs and Pesticides and	RM 2.5	Near surface at each sampling location and near sediment of river mile 2.5.	1st month during Ebb tide/ 2nd month during flood tide. Sample at varying

	related conventionals.			particulate levels.
Day 5	Collect HSMVS samples for PCBs, Dioxins/Furans, PAHs and Pesticides and related conventionals.	RM 10.5	Near surface at each sampling location.	1st month during Ebb tide/ 2nd month during flood tide. Sample at varying particulate levels.

Attachment 9: Battelle Biological Data Compilation

Battelle memorandum dated October 31, 2005 presenting biological data available from the CARP and PREmis databases for select biological species and select chemicals.

Battelle
The Business of Innovation

Project Number G004668-WAD6WO73

Date October 31, 2005

To Bruce Fidler, Len Warner, AmyMarie Accardi-Dey (Malcolm Pirnie)

From Greg Durell, Erika Schaub (Battelle)

Subject Lower Passaic River Restoration Project: Preparation of Biological Tissue Data Plots

Internal Distribution
E. Barrows
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This memo summarizes Battelle's procedures associated with work conducted as part of WAD 6, Data Management and Presentation, WO 7.3: Preliminary Geochemical and Statistical Analyses, for the Lower Passaic River Restoration Project. Specifically, this subtask was conducted to generate a series of plots illustrating concentrations of selected contaminants in tissue samples collected from the Passaic River. This subtask was a component of Malcolm Pirnie's Historical Data Evaluation and Geochemical Evaluation task.

TASK DESCRIPTION AND SCOPE SUMMARY

A Task Plan was developed by Battelle specifically for this task, based on the original May 2005 Statement of Work and discussions with Malcolm Pirnie. The Task Plan was revised following discussions between Malcolm Pirnie and Battelle. The last revision of the Task Plan, which describes the Scope of Work in detail, was dated 10/17/2005.

The following is a brief summary of the Scope of Work for this task. In this biological data review and plotting exercise, the following chemicals were examined:

- Total DDT (the sum of 4,4′-DDT, 4,4′-DDD, and 4,4′-DDE)
- 2,3,7,8-TCDD
- Ratio of 2,3,7,8-TCDD to Total Tetra-CDD
- Total PAH (as the sum of the 16 USEPA priority pollutant PAH)
- Total PCB (as the sum of all 18 NOAA congeners multiplied by 2, or the sum of Aroclors)
- Total Mercury
- Ratio of Methyl Mercury to Total Mercury
- Total Lead

Using data files available on PREmis and Passaic river tissue data from the CARP database, Battelle compiled the historical biological data and prepared three sets of plots:

- Deliverable I. Scatter Plots showing the concentration of biological tissue concentration versus river mile. Species of interest were Blue Crab, Mummichog, and White Perch.

- Deliverable II. Scatter plot of the ratio of the lipid-normalized biological tissue concentration and the TOC-normalized surficial sediment concentration versus river mile. Species of interest were Blue Crab, Mummichog, and White Perch.

- Deliverable III. Scatter plot showing the tissue contaminant concentrations from laboratory sediment bioaccumulation tests the using laboratory organisms *Macoma nasuta* and *Nereis virens*.

APPROACH

All of the deliverables were plotted using Microsoft Excel. Separate plots were generated for each of the three species, and the tissue concentrations for each parameter were plotted versus actual river mile. The intent was to plot data from the entire 17 mile Passaic River study area. However, there were only data from the lower 7 miles for the species and parameters of interest.

The data for deliverable plots I and II were grouped into four time periods; 1992-1993, 1994-1995, 1998-1999, and 2000-2005 and illustrated on the same plot. No data were available from 1990-1991, or 1996-1997 for the species and parameters of interest. Each year range was plotted using its own symbol and color. Bioaccumulation data were only available for 1993 for sediments collected in the Passaic River, and therefore data for deliverable III were plotted by species (*Macoma nasuta* and *Nereis virens)*.

River miles were assigned to each station using a rivermile file obtained from Malcolm Pirnie, Inc., which had station location information, and the centerline01mileseg.shp file obtained through the PREmis website, which also had river mile information. Samples were then plotted by river mile in ArcInfo to ensure that they were assigned an appropriate river mile. The location of two stations, BCH1 and BCH2, were changed as per a letter from TSI dated 08/24/2005. The location of some of the CARP stations were also adjusted as per information obtained from NOAA. One blue crab station (40.74416,-74.13033) was not identified to be moved but it was within 200 feet of a fish station identified to be moved. Since the blue crab station did not originally map inside of a water body and the neighboring fish station was moved to a location inside of the Passaic River, both the blue crab and fish stations were moved to the same location, 40.74749, -74.1294.

To obtain data for the three different deliverable types, river mile information for those stations which were in the Passaic River was added to the original PREmis table, dbo_viewSampleDownloadTable, and those stations not in the study area were removed from the table. Any Passaic River data from the Newark Bay TSI study were also removed from the analysis because they were replicates of samples already in the dataset under a different study name. For ease of plotting the data, river mile stations were rounded to 0.1 mile. All parameters with a concentration/value reported as non-detect, or with a qualifier of U, were reassigned a value of zero.

A query was performed in Microsoft Access for each parameter of interest; a new table was created for each parameter. The query was performed using the column Param_Code. Table 1 identifies each parameter and the code(s) used in the query.

The next step was to sum the individual parameter results for the following: DDT, PAH, NOAA_Congeners, and PCB_Aroclor. This was performed by summing all values having the same entries in the analysis_id column to ensure that data from the same sample were used (e.g., all -1's were summed, all -2's were summed, etc.). The summations were performed in MS Access after retrieving the data from PREmis. Total DDT was calculated by summing the concentrations of the 4,4'-isomers of DDT, DDD, and DDE. Total PAH was calculated by summing the concentrations of the 16 priority pollutant PAH. PCB data reported as NOAA_Congener values were converted to Total PCB by summing the concentrations of the 18 NOAA congeners and multiplying by 2, and PCB data reported as PCB_Aroclor were converted to Total PCB by summing the concentrations of the reported Aroclors. It was noted that the original PREmis data did not always include all parameters used for the summation (i.e., there was not always data for all 16 PAH). The reason why all parameters were sometimes not included in PREmis was not investigated, and the summations were based on the available parameters.

The tissue data was identified by the values in the Matrix_Code column. Table 2 lists which matrix codes used to identify the tissue data for this activity.

Table 1. All of the Parameter Codes Identified to Query the PREmis and CARP Data

Parameter	Param_Code
2,3,7,8_TCDD	"1746-01-6"
DDT	"72-54-8" Or "72-55-9" Or "50-29-3"
Lead	"7439-92-1"
Lipids	"LIPIDS"
Mercury	"7439-97-6"
MethylMercury	"22967-92-6"
NOAA_Congeners	"31508-00-6" Or "35693-99-3" Or "38380-07-3" Or "35065-30-6" Or "35065-29-3" Or "32598-10-0" Or "40186-72-9" Or "32598-14-4" Or "37680-73-2" Or "37680-65-2" Or "35065-28-2" Or "35065-27-1" Or "34883-43-7" Or "7012-37-5" Or "2051-24-3" Or "52663-68-0" Or "52663-78-2" Or "41464-39-5"
PAH	"53-70-3" Or "120-12-7" Or "91-20-3" Or "56-55-3" Or "208-96-8" Or "218-01-9" Or "83-32-9" Or "205-99-2" Or "120-12-7" Or "207-08-9" Or "86-73-7" Or "50-32-8" Or "206-44-0" Or "191-24-2" Or "85-01-8" Or "193-39-5" Or "129-00-0" Or "53-70-3"
PCB_Aroclor	"11097-69-1" Or "12674-11-2" Or "11096-82-5" Or "53469-21-9" Or "12672-29-6" Or "11104-28-2" Or "11141-16-5"
Total_TCDD	"TOT_41903-57-5" Or "41903-57-5"
TOC	"TOC"

Table 2. Matrix Codes and Matrix Type for Tissue Data

Matrix	Matrix_Code
anterior half standard fillet	AHF
Carcass	CARC
whole fish	CW
dorsal fin steak	DFS
Hepatopancreas	HEP
head and viscera removed	HV
Muscle	MSCL
fillet without skin	NOSKFL
remnant carcass	RC
right fillet	RF
standard fillet	SF
fillet and liver composited	SF+LV
soft tissue	SOF
steak scute 2 (anterior)	SS2
steak scute 6 (posterior)	SS6
Tissue	TISSUE
whole fish	WH
whole fish with no liver	WH-LV
whole bodies composited	WHLBD

Per request, fish tissue data from different tissue types were plotted in the same figures because each study had different methodology and tissue samples were reported differently in PREmis (e.g., whole fish, carcass, and fillet and liver composite are all plotted together). The species code was included in the query by linking the information in the dbo_Samples table to the dbo_viewSampleDownloadTable by the Sample_ID column. The following species were of interest for the different plots: Blue Crab (together with those designated as just Crab), Mumichog, White Perch, *Macoma nasuta* and *Nereis virens*. Some of the parameters of interest were to be plotted as ratio values; the sample values of the 2,3,7,8-TCDD to Total TCDD and Methyl Mercury to Total Mercury.

The Blue Crab data and the Fish data in CARP were in a different format, and needed to be queried separately from the PREmis database. The queries were similar in that all non-detects and any with "U" qualifiers were given a value of "0". Units for some of the parameters were not in ng/g and were converted to ng/g. The parameter codes were the same and the appropriate sample values were adjusted in the same manner as described above for the PREmis database.

Sediment data was also identified and placed into a separate table by parameter. This query was performed, again in Microsoft Access, and used the following criteria:

Sample_Type	"Surficial Sediment Grabs"
Depth_Top	0
Depth_Bottom	<0.58

(Assumption- Not all of the records had depth units listed, but most of the units identified were feet, so the assumption was that the records with no depth unit was recorded in feet).

The number of records that were retrieved from the databases and available for plotting can be found in Attachment 1. No data were found from 1990-1991 or 1996-1997 for the species and contaminant parameters of interest. All data points that were plotted are for discrete and separate samples. This may include multiple animals (crab or fish) that were collected at the same time at the same location, but were then analyzed separately.

Deliverables I and III were plotted from the single table outputs provided in Microsoft Access and exported into Microsoft Excel . Deliverable II required additional analyses to produce. Sample data in both the Tissue and Sediment tables were divided by Lipid and TOC results for each sample, respectively. The TOC normalized surface sediment data was averaged for all sediment samples that were collected the same year and within ½ mile of the associated tissue sample. Then Lipid normalized tissue data was then divided by the average TOC normalized sediment data. The plotted normalized results were thus calculated as follows, using the units indicated in numbers 3 through 5 in the list of assumptions below:

$$(([\text{tissue contaminant}] \div [\text{tissue lipid}]) \div ([\text{sediment contaminant}] \div [\text{sediment TOC}]))$$

Assumptions and Other Information for the Plots:

1. It was assumed that the values in the SampleResultPPBValue column in the dbo_viewSampleDownloadTable were in ng/g; these are the concentration data fields that were used for this task.
2. It was assumed that the location information, concentration values, and assumed concentration units obtained from PREmis were accurate; the quality and accuracy of the data in the PREmis database is not fully known and was not further checked for this exercise.

3. It was assumed that the tissue data retrieved from PREmis were all in ng/g wet weight and sediment data were assumed to be in ng/g dry weight. These are the data that have been plotted.
4. It was assumed that the tissue lipid data in PREmis were in percent wet weight, and the results remained as a percent for the data normalization.
5. The TOC data were reported as either percent or ng/g in PREmis, and the values in the percent were assumed to be g/100g. The units of the data reported in ng/g data were converted to g/100g (percent), for consistency, and the results remained as a percent for the data normalization. It was assumed that the TOC data were on a dry weight basis, like the sediment contaminant data.
6. The lipid- and TOC-normalized ratio plots (Deliverable II) were generated based on lipid-normalized tissue data on a wet weigh basis (see #4 above) divided by TOC-normalized sediment data on a dry weight basis (see #5 above), and as indicated with the equation above.
7. Some of the records were missing depth units. Most of the depth units were recorded in feet, therefore it was assumed that all records were recorded in a depth of feet.
8. Samples identified as Crab were assumed to be Blue Crab data, and plotted with the Blue Crab data.

The queries went through a QA/QC procedure developed through Battelle's Quality Assurance Program. The results of the QA/QC procedure can be found in Attachment 2.

Attachment 1
Number of Records Available for Plotting

Year	Species	Number of Field Tissue Samples							
		Total DDT (4,4-DDT/DDD/DDE)	2,3,7,8-TCDD	Total Tetra-CDD	Total PAH	Total PCB	Mercury	Methyl-Mercury	Lead
1990-1991	Blue crab	0	0	0	0	0	0	0	0
	White Perch	0	0	0	0	0	0	0	0
	Mummichog	0	0	0	0	0	0	0	0
1992-1993	Blue crab	2	4	4	0	2	2	0	2
	White Perch	0	0	0	0	0	0	0	0
	Mummichog	0	0	0	0	0	0	0	0
1994-1995	Blue crab	6	6	6	6	12	6	6	6
	White Perch	5	1	1	0	5	5	0	0
	Mummichog	5	5	5	5	15	5	5	5
1996-1997	Blue crab	0	0	0	0	0	0	0	0
	White Perch	0	0	0	0	0	0	0	0
	Mummichog	0	0	0	0	0	0	0	0
1998-1999	Blue crab	65	56	56	113	139	65	0	60
	White Perch	29	21	21	31	51	29	0	9
	Mummichog	51	51	51	100	102	51	0	21
2000-2005	Blue crab	7	7	7	14	14	7	0	7
	White Perch	25	25	25	40	50	35	0	6
	Mummichog	6	6	6	9	13	7	0	4

Year	Number of Field Surface Sediment Samples			
	Total DDT (4,4-DDT/DDD/DDE)	2,3,7,8-TCDD	Total PAH	Total PCB
1990-1991	34	30	31	57
1992-1993	37	48	36	60
1994-1995	139	137	138	357
1996-1997	0	0	0	3
1998-1999	57	57	114	114
2000-2005	17	17	34	34

Number of Field Surface Sediment Samples with both Contaminant and TOC Data			
Total DDT (4,4-DDT/DDD/DDE)	2,3,7,8-TCDD	Total PAH	Total PCB
25	21	24	25
37	48	36	39
138	133	138	219
0	0	0	0
57	57	114	57
17	17	34	17

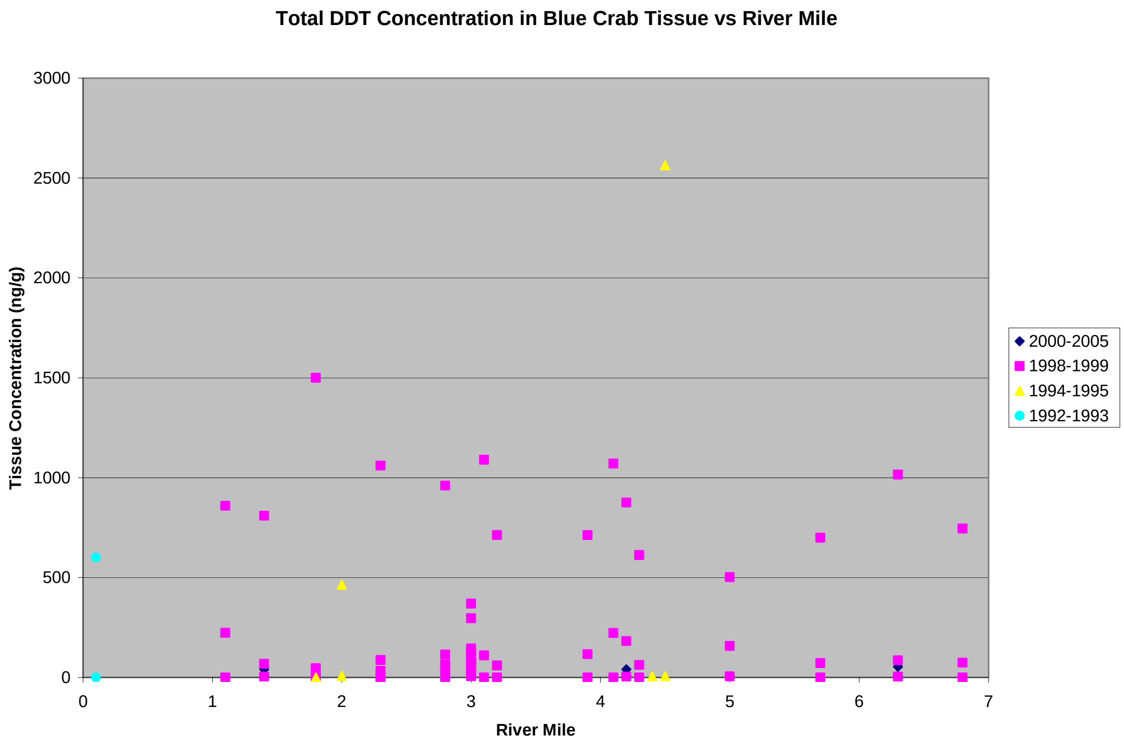
Year	Number of Field Tissue Samples Available for Deliverable II Plots[a]			
	Total DDT (4,4-DDT/DDD/DDE)	2,3,7,8-TCDD	Total PAH	Total PCB
1990-1991	0	0	0	2
1992-1993	2	0	0	0
1994-1995	5	0	0	5
1996-1997	0	0	0	0
1998-1999	27	10	20	67
2000-2005	12	0	0	23

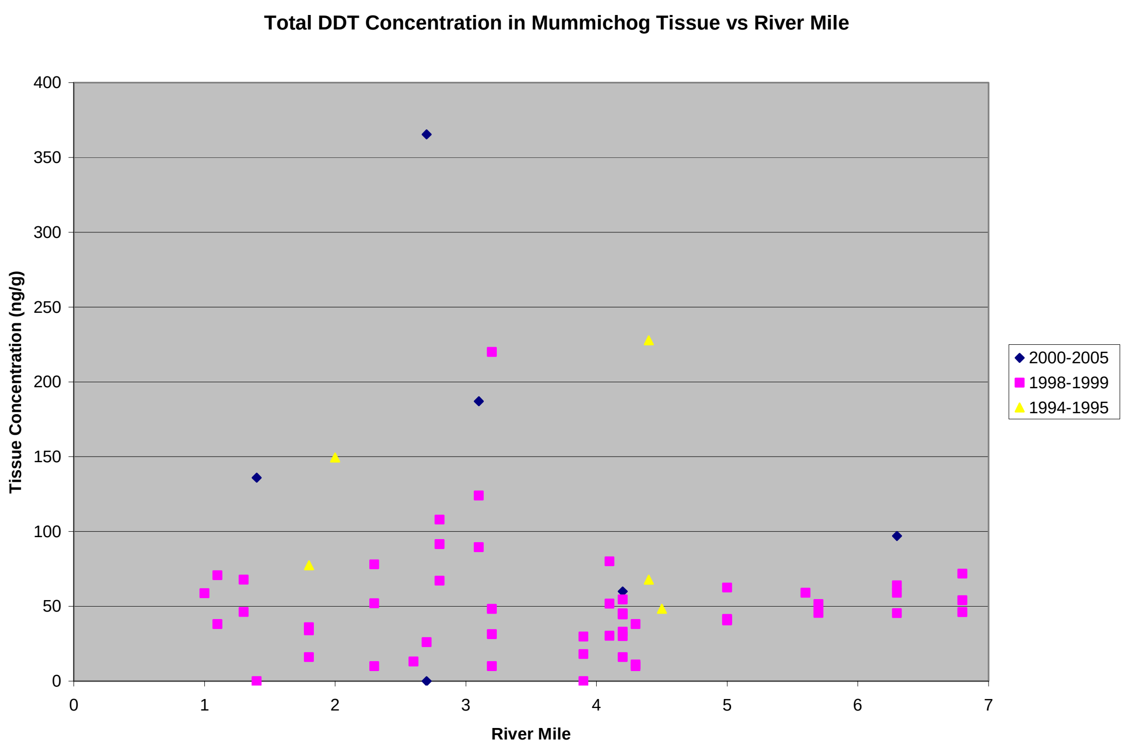
[a] Number of tissue samples with contaminant and lipid data collected in a location where there were also sediment sample(s) with contaminant and TOC data collected within ½ mile of the tissue sample.

Year	Species	Number of Laboratory Tissue Samples from Bioaccumulation Tests Using Sediments from the Passaic River							
		Total DDT (4,4-DDT/DDD/DDE)	2,3,7,8-TCDD	Total Tetra-CDD	Total PAH	Total PCB	Mercury	Methyl-Mercury	Lead
1990-1991	*Macoma nasuta*	0	0	0	0	0	0	0	0
	Nereis virens	0	0	0	0	0	0	0	0
1992-1993	*Macoma nasuta*	5	0	0	5	5	5	0	5
	Nereis virens	5	1	0	5	5	5	0	5
1994-1995	*Macoma nasuta*	0	0	0	0	0	0	0	0
	Nereis virens	0	0	0	0	0	0	0	0
1996-1997	*Macoma nasuta*	0	0	0	0	0	0	0	0
	Nereis virens	0	0	0	0	0	0	0	0
1998-1999	*Macoma nasuta*	0	0	0	0	0	0	0	0
	Nereis virens	0	0	0	0	0	0	0	0
2000-2005	*Macoma nasuta*	0	0	0	0	0	0	0	0
	Nereis virens	0	0	0	0	0	0	0	0

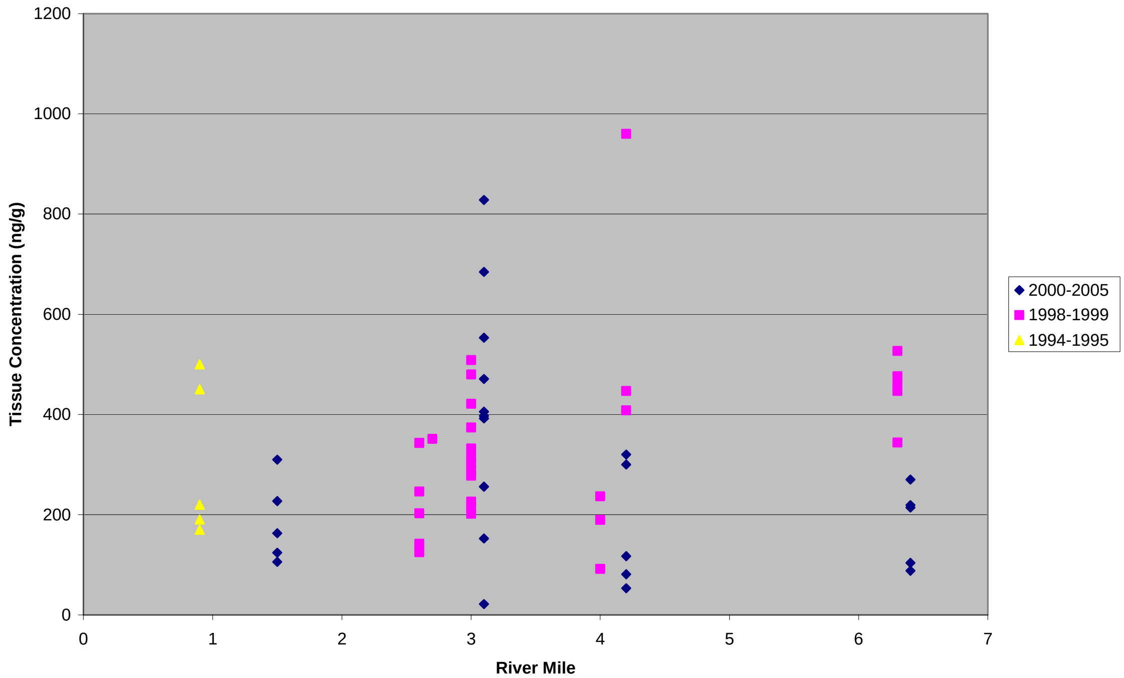
Deliverable I

I.1 Total DDT

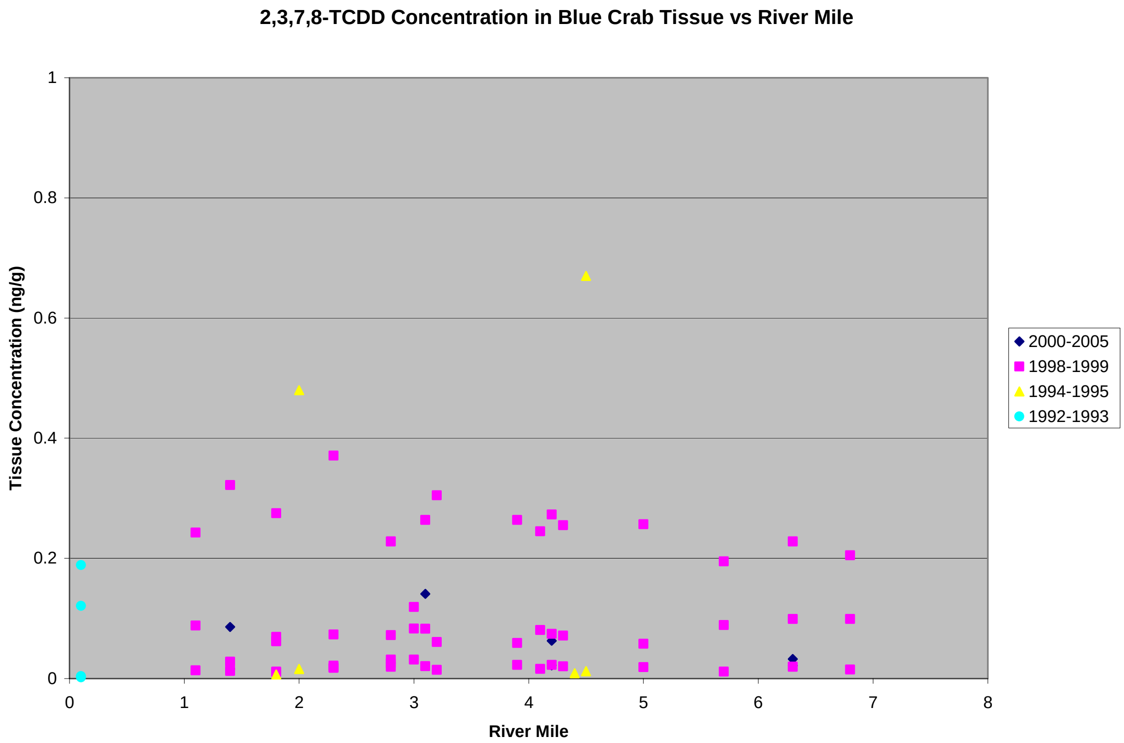




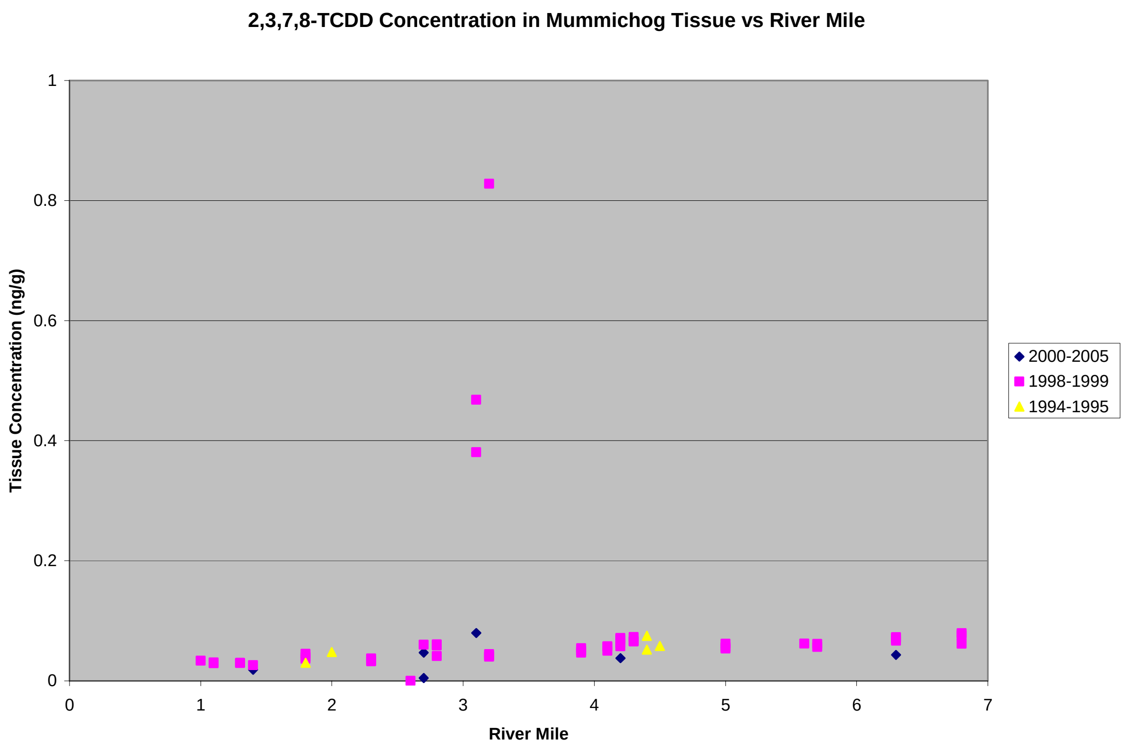
Total DDT Concentraion in White Perch Tissue vs River Mile



I.2 2,3,7,8-TCDD

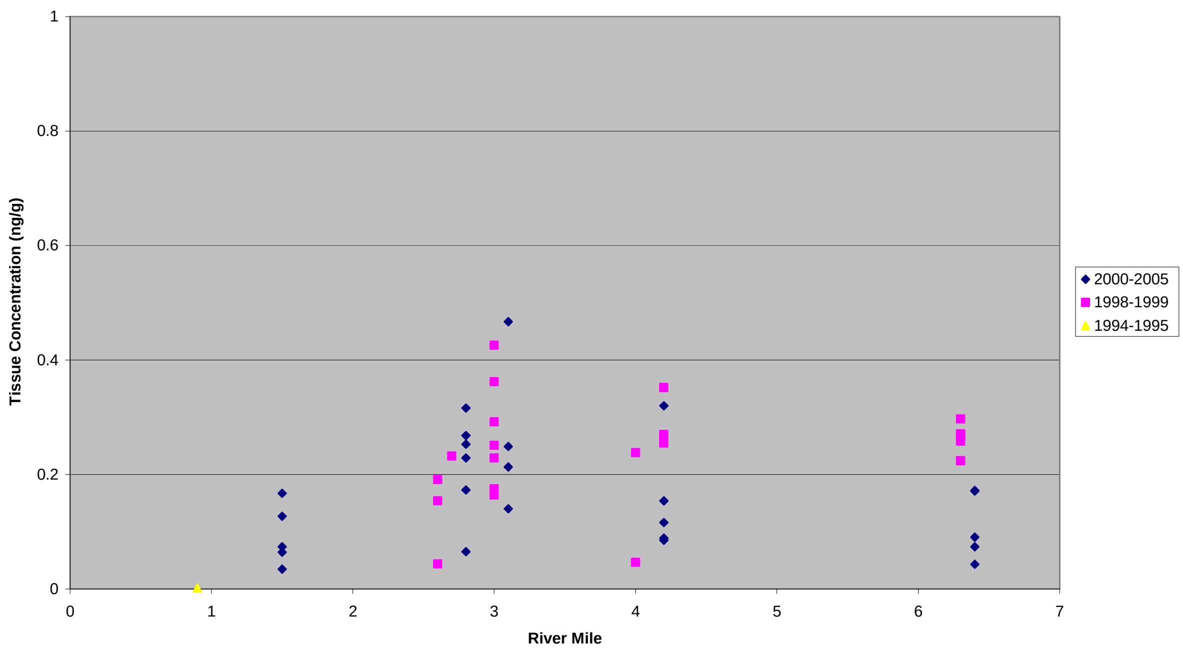


2,3,7,8-TCDD Concentration in Blue Crab Tissue vs River Mile
Tissue Concentration (ng/g)
River Mile
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
6
7
8
2000-2005
1998-1999
1994-1995
1992-1993

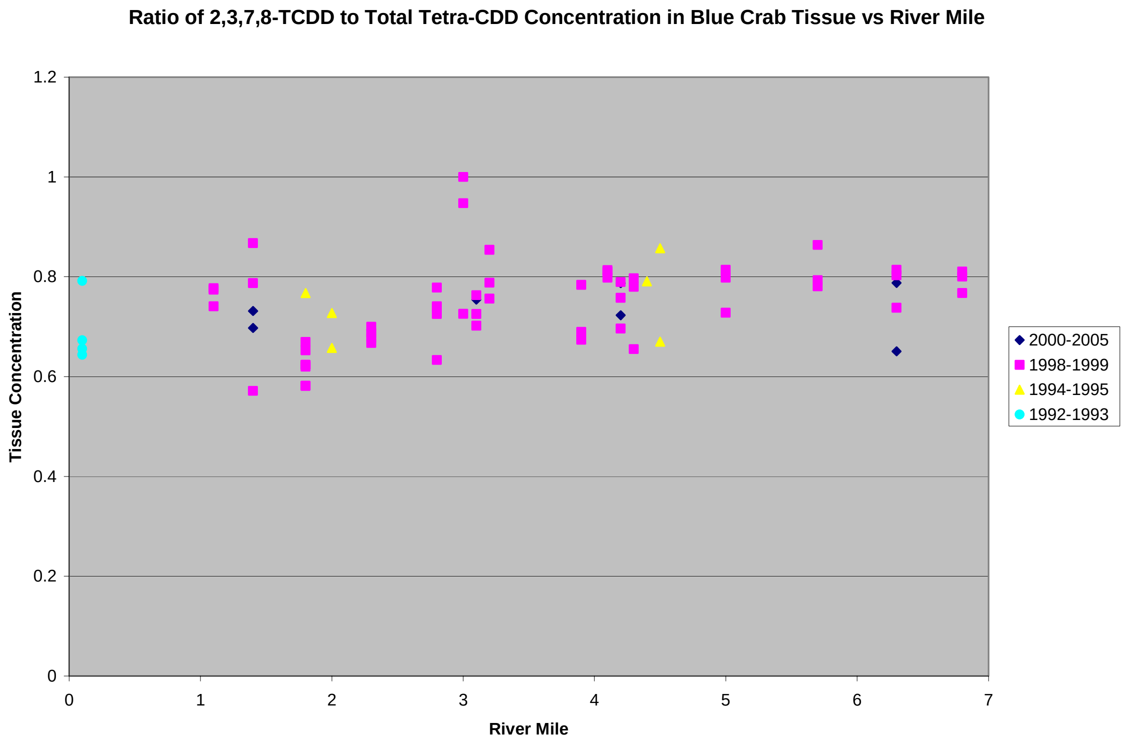


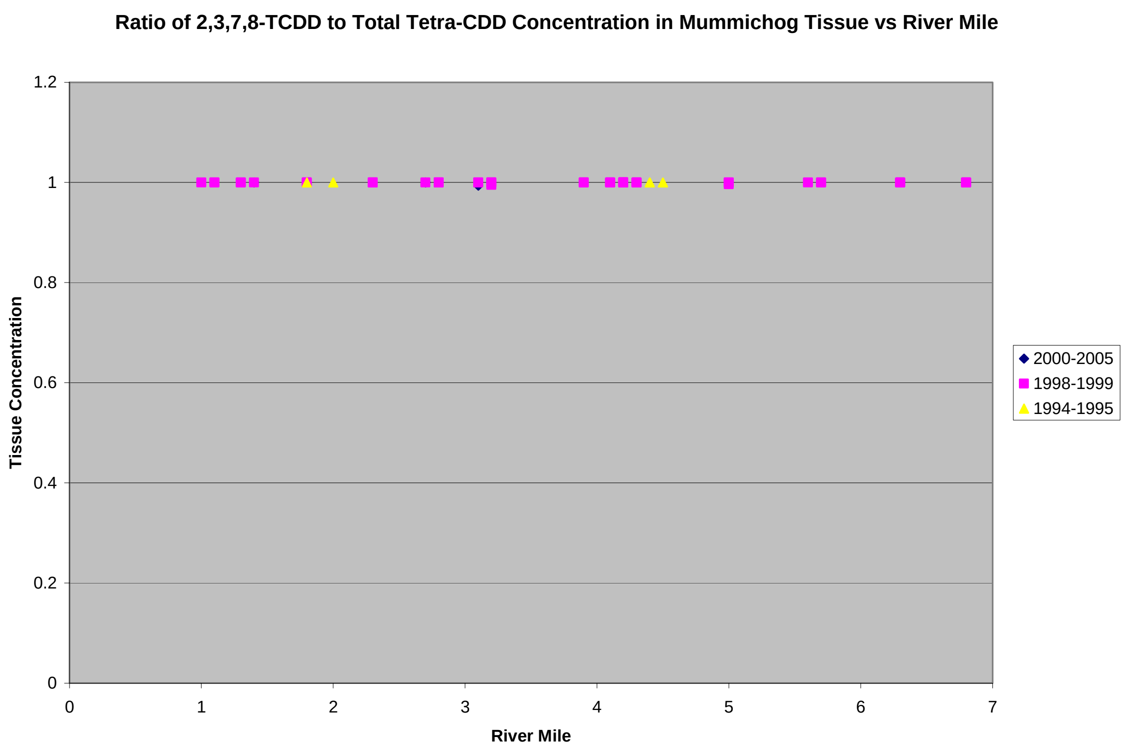
2,3,7,8-TCDD Concentration in Mummichog Tissue vs River Mile
Tissue Concentration (ng/g)
River Mile
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
6
7
2000-2005
1998-1999
1994-1995

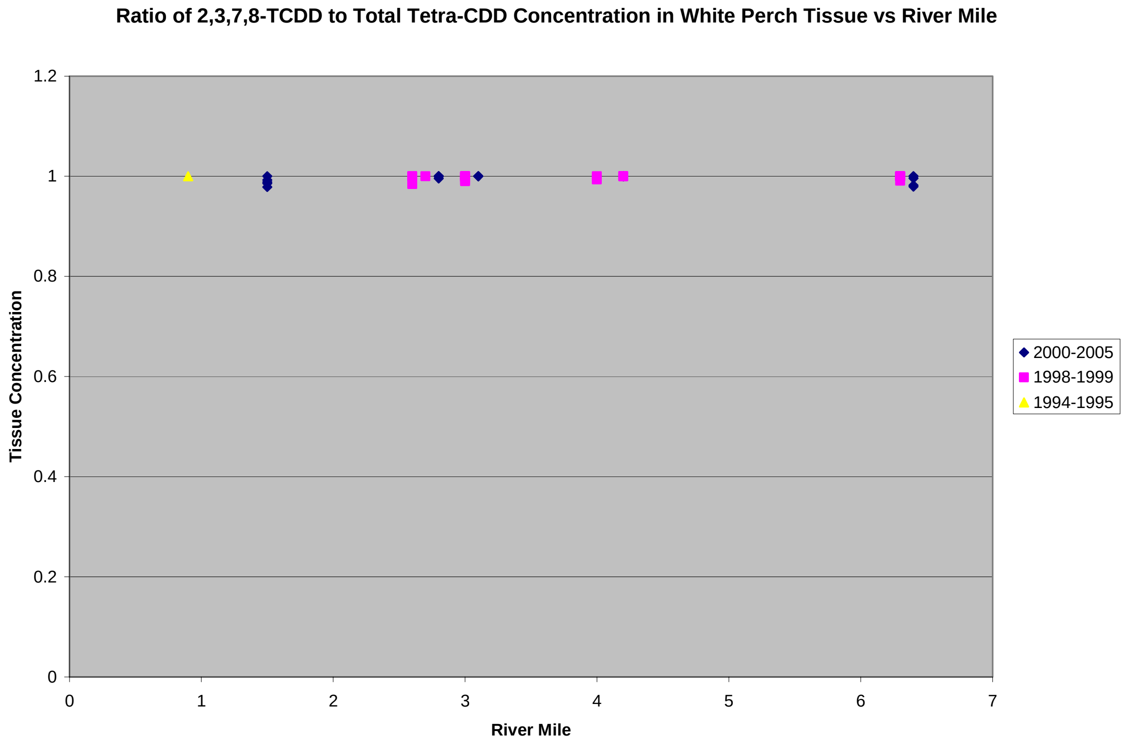
2,3,7,8-TCDD Concentration in White Perch Tissue vs. River Mile



I.3 Ratio of 2,3,7,8-TCDD to Total Tetra-CDD

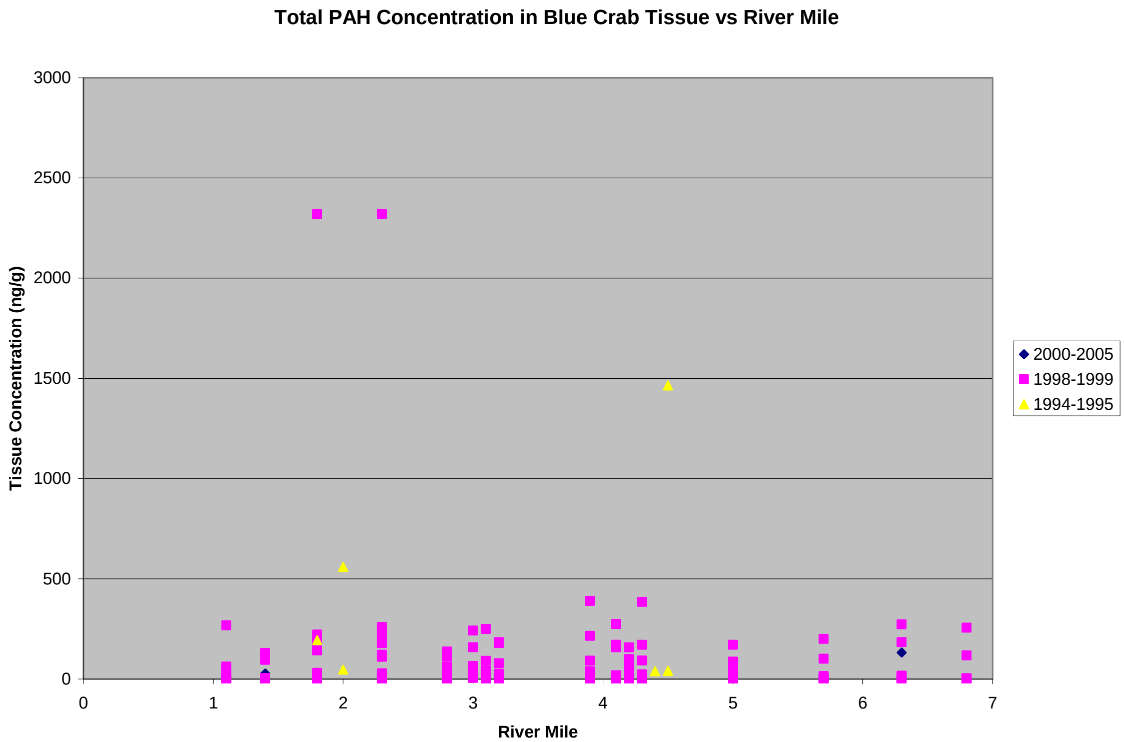


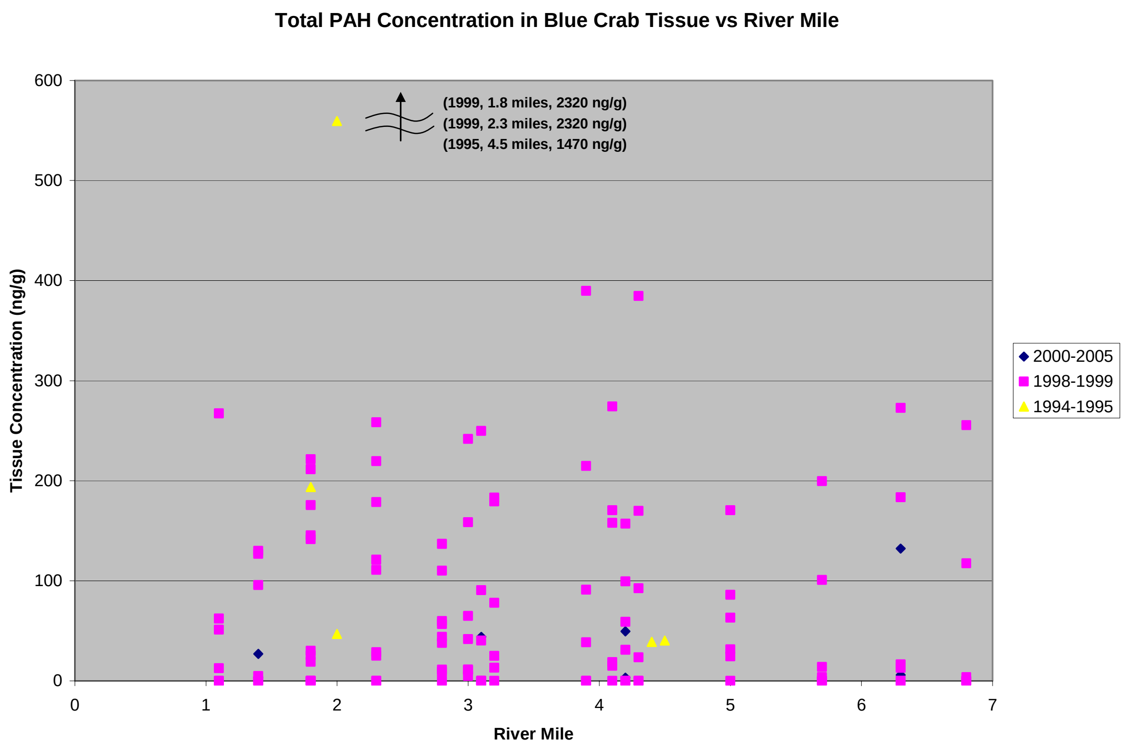




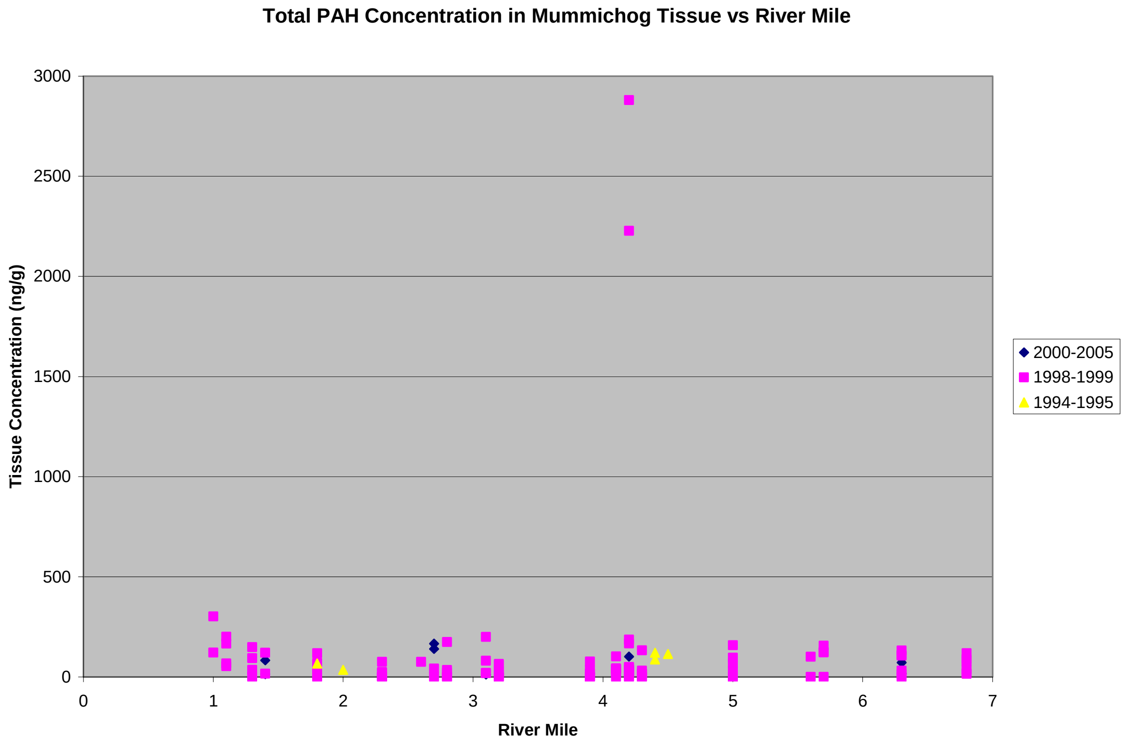
Ratio of 2,3,7,8-TCDD to Total Tetra-CDD Concentration in White Perch Tissue vs River Mile
Tissue Concentration
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
River Mile
2000-2005
1998-1999
1994-1995

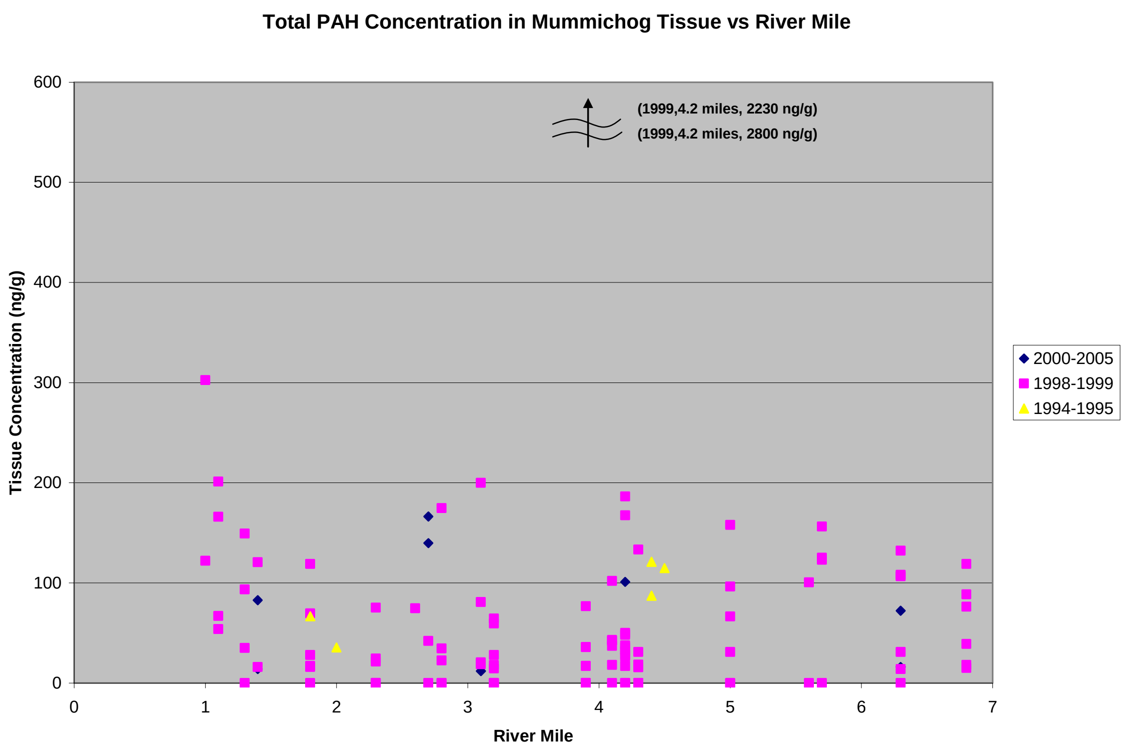
I.4 Total PAH



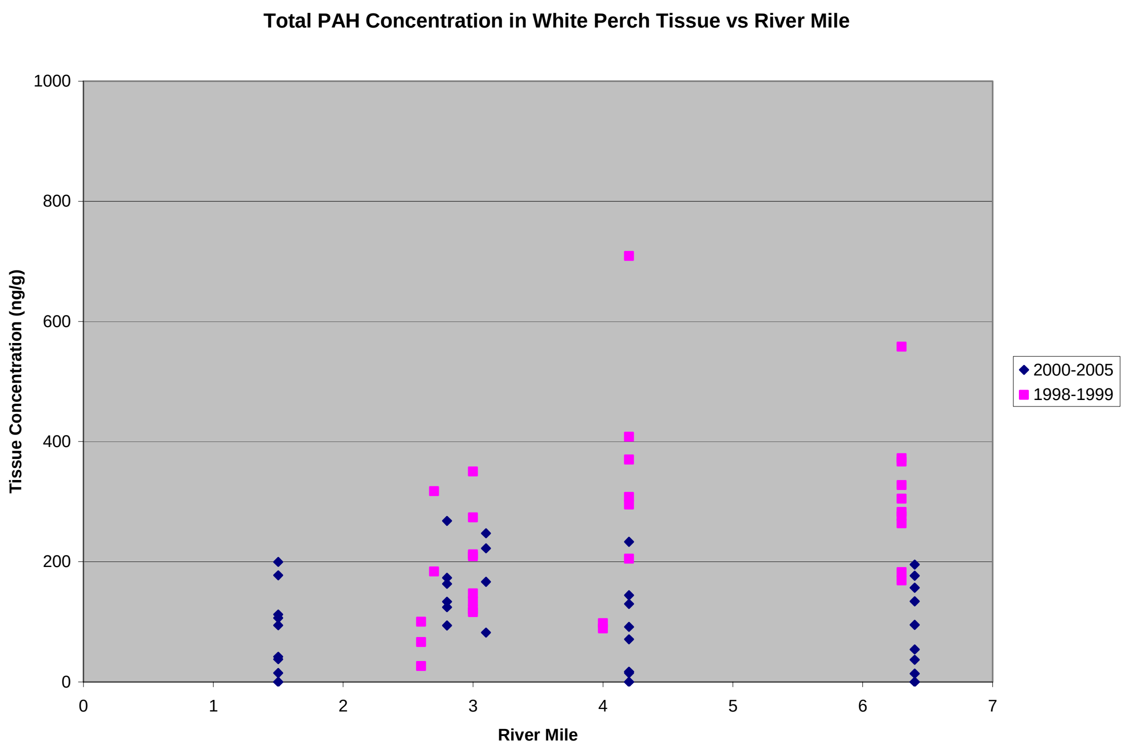


REPLICATE BLUE CRAB PLOT, WITH A REDUCED CONCENTRATION SCALE



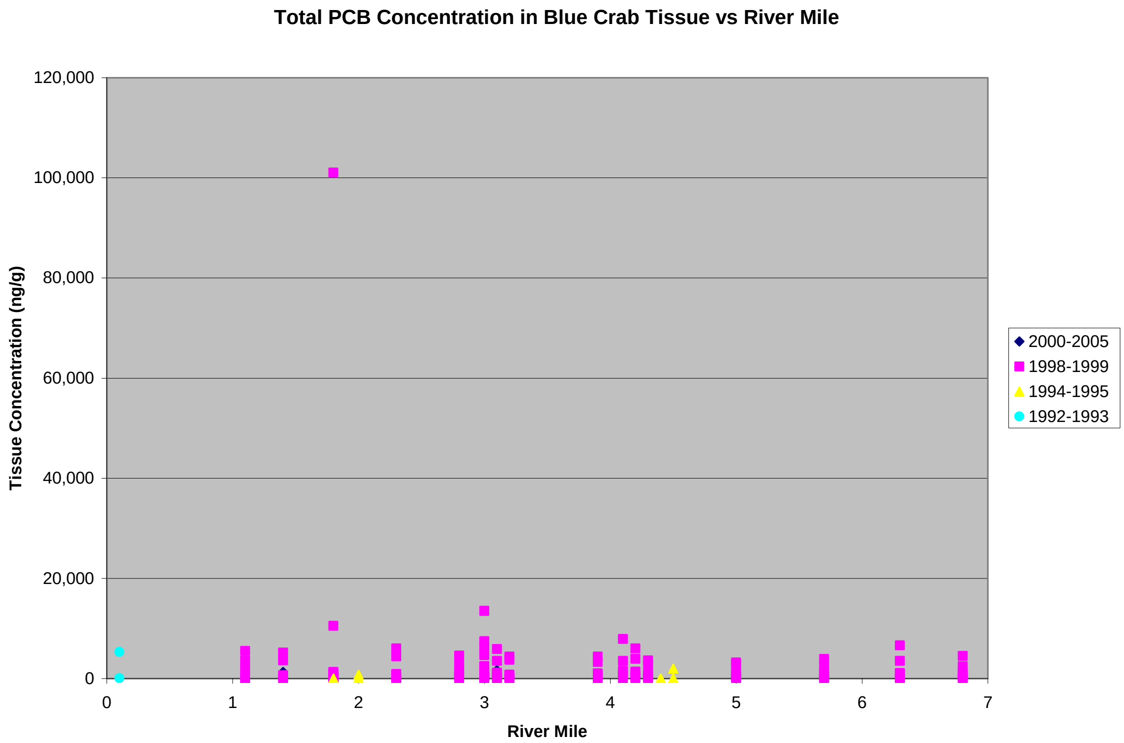


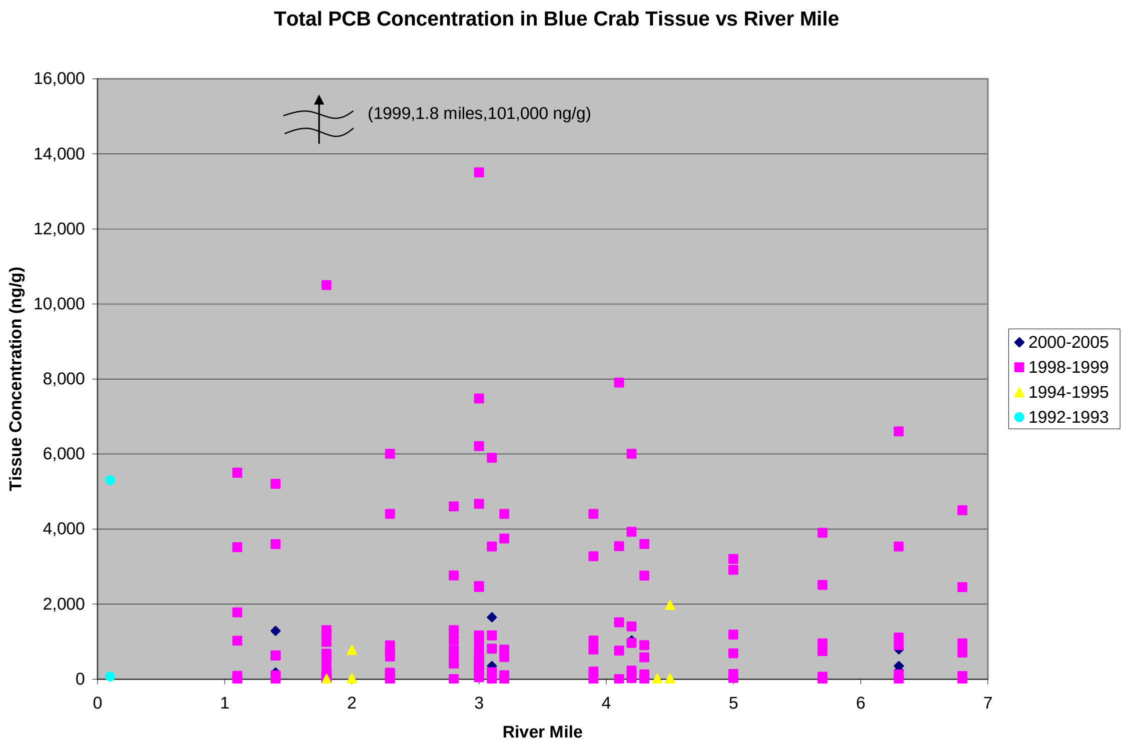
REPLICATE MUMMICHOG PLOT, WITH A REDUCED CONCENTRATION SCALE



Total PAH Concentration in White Perch Tissue vs River Mile
Tissue Concentration (ng/g)
1000
800
600
400
200
0
0
1
2
3
4
5
6
7
River Mile
2000-2005
1998-1999

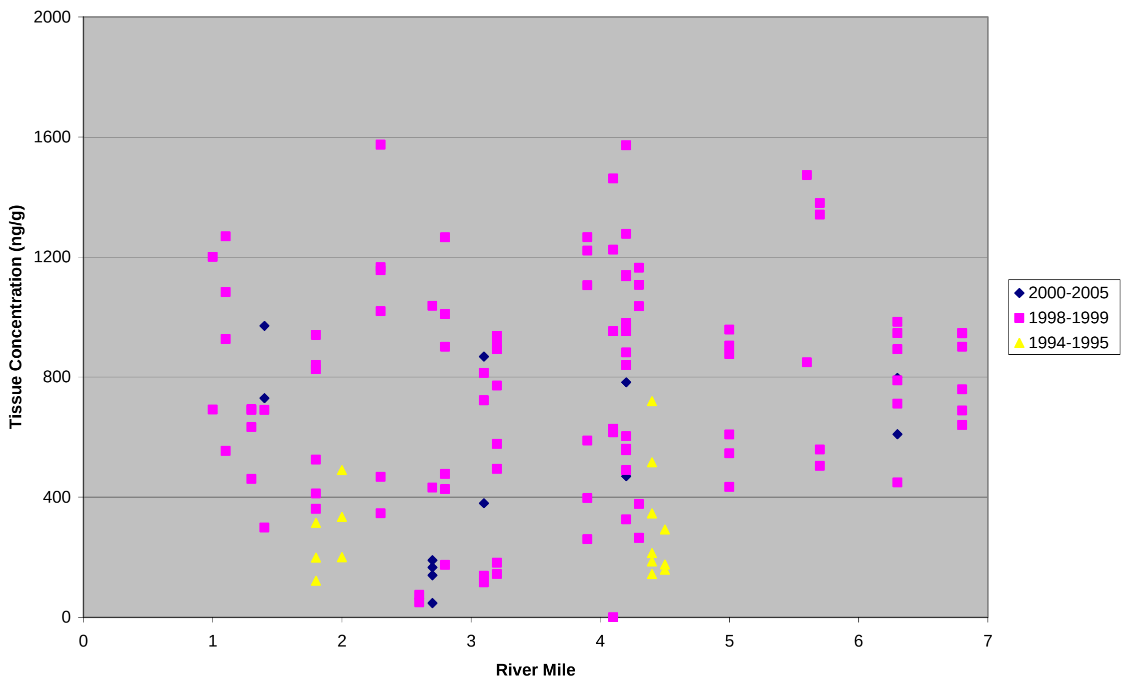
I.5 Total PCB



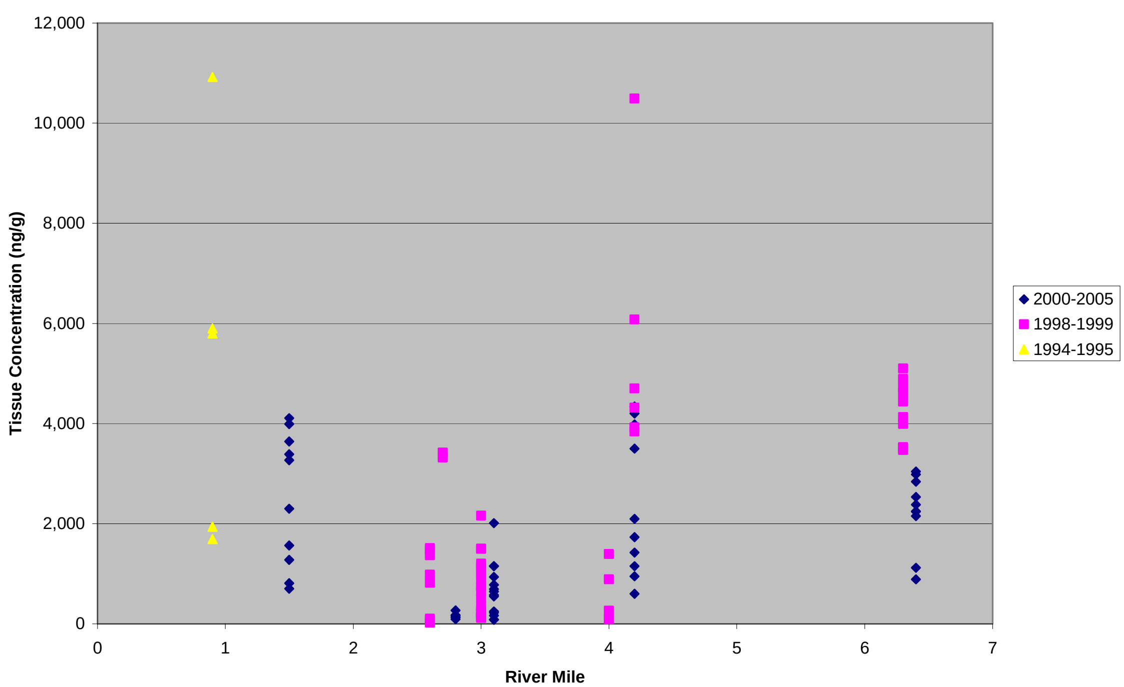


REPLICATE BLUE CRAB PLOT, WITH A REDUCED CONCENTRATION SCALE

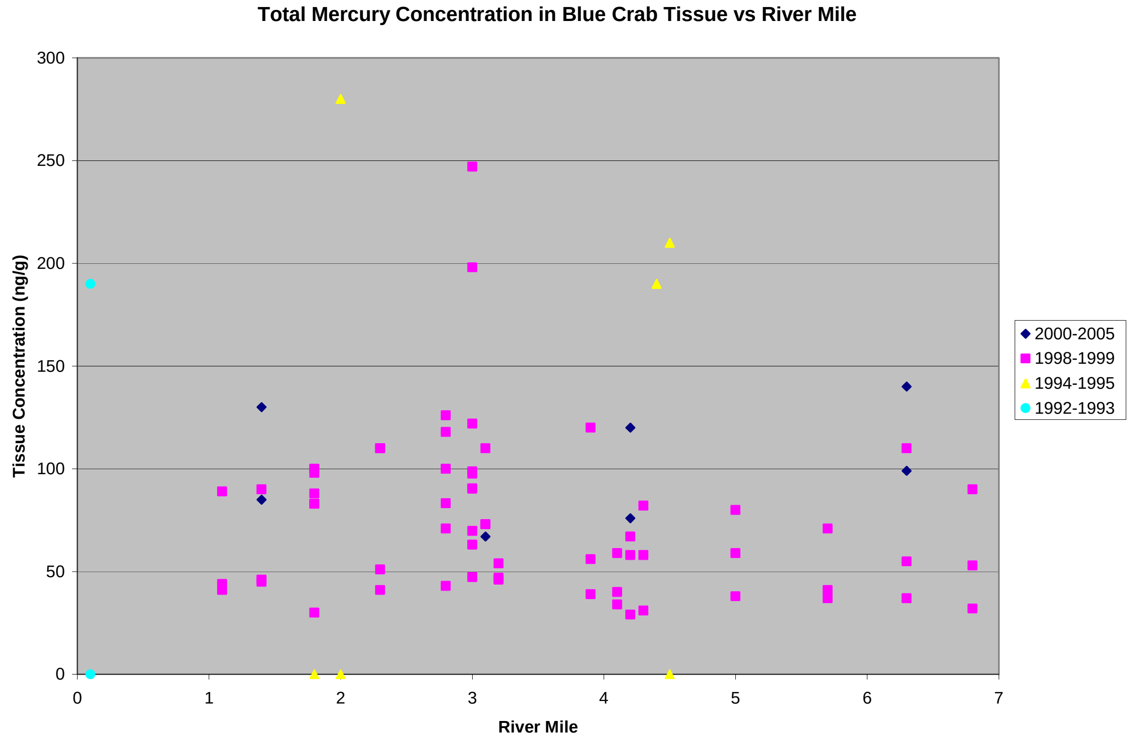
Total PCB Concentration in Mummichog Tissue vs River Mile

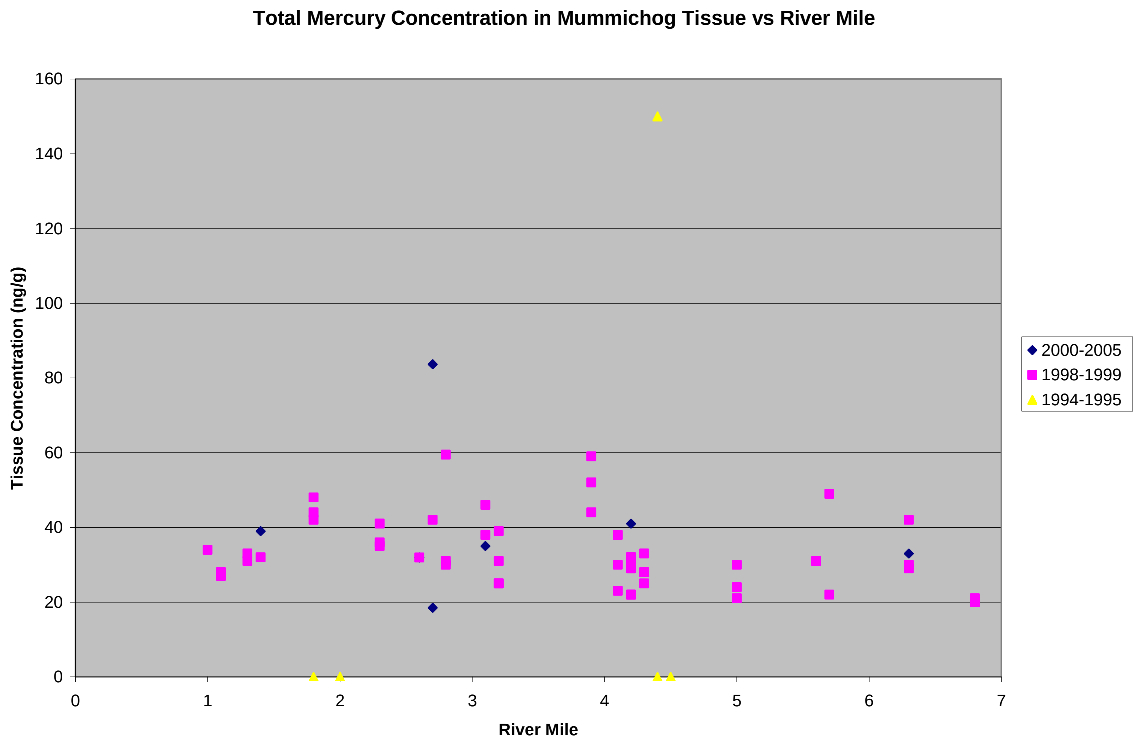


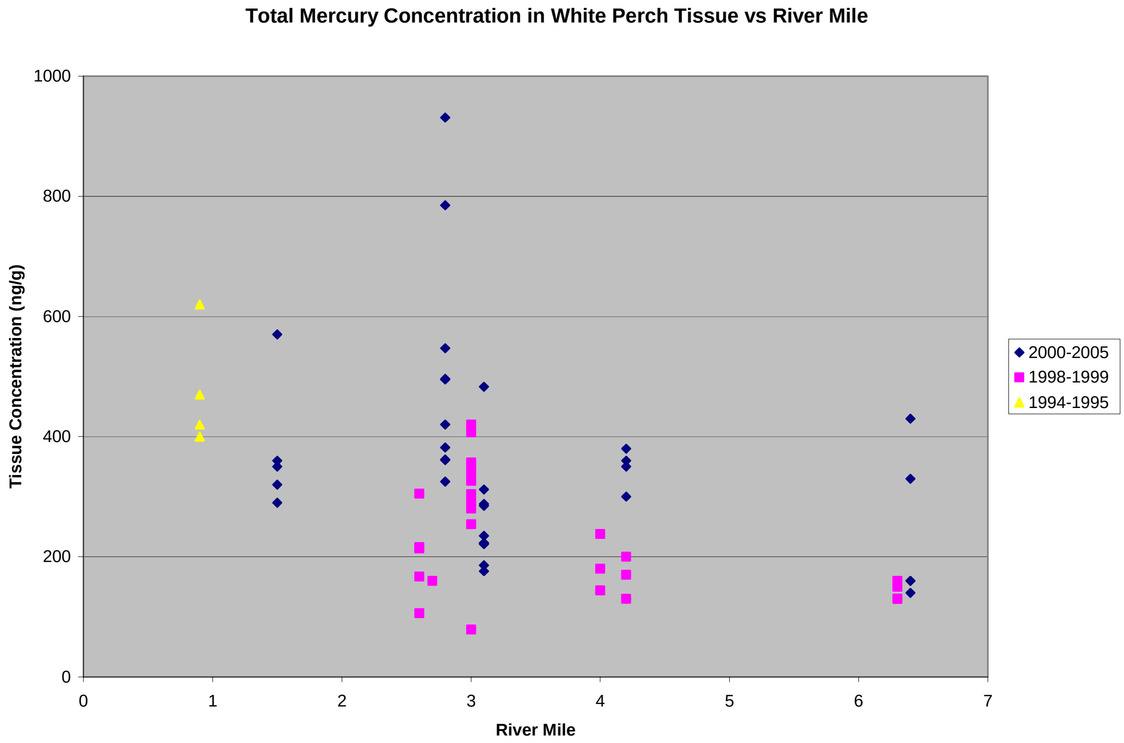
Total PCB Concentration in White Perch Tissue vs River Mile



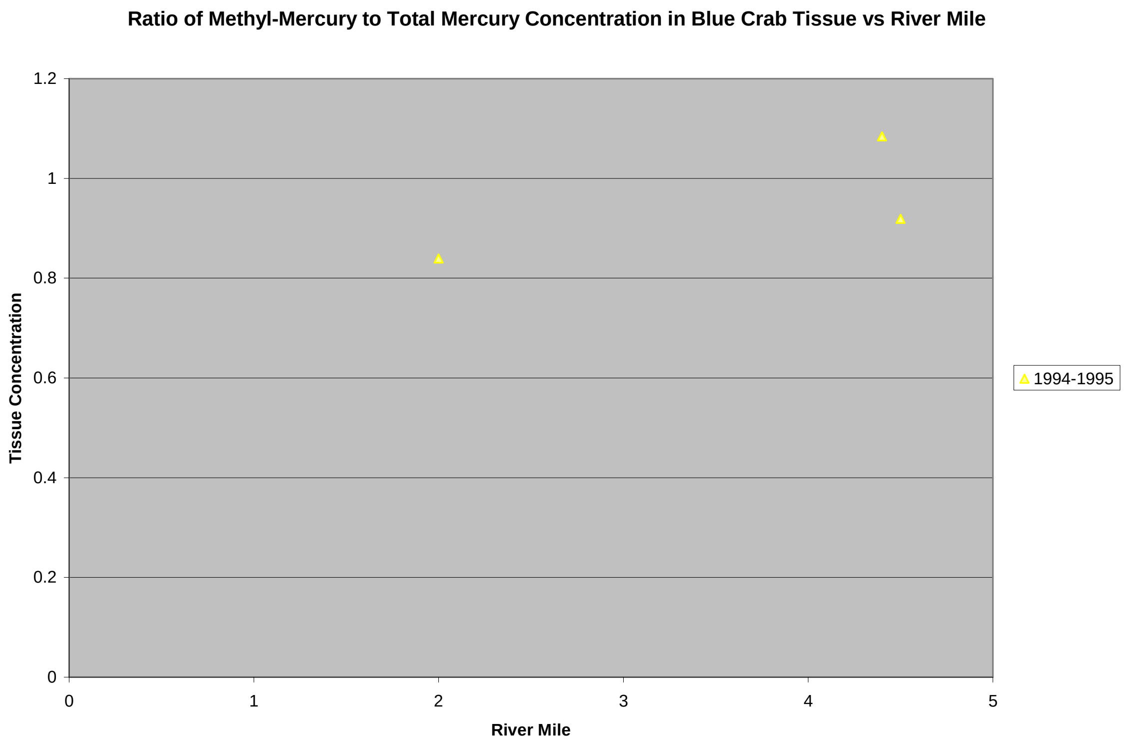
I.6 Total Mercury

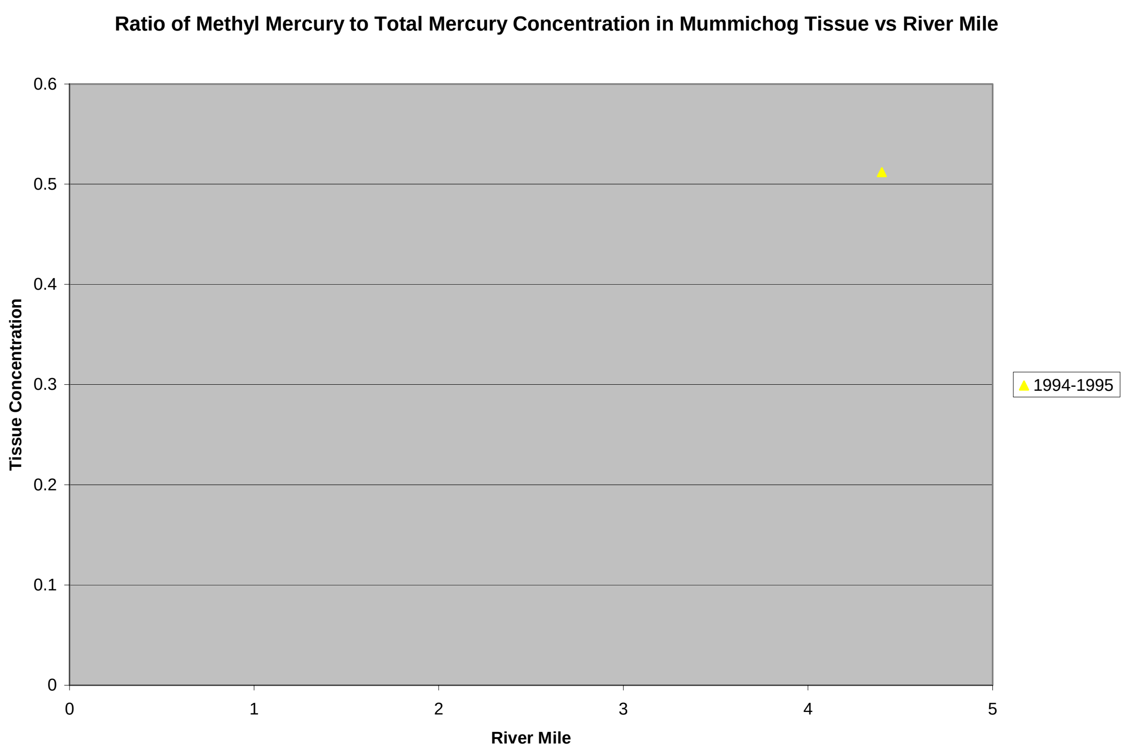




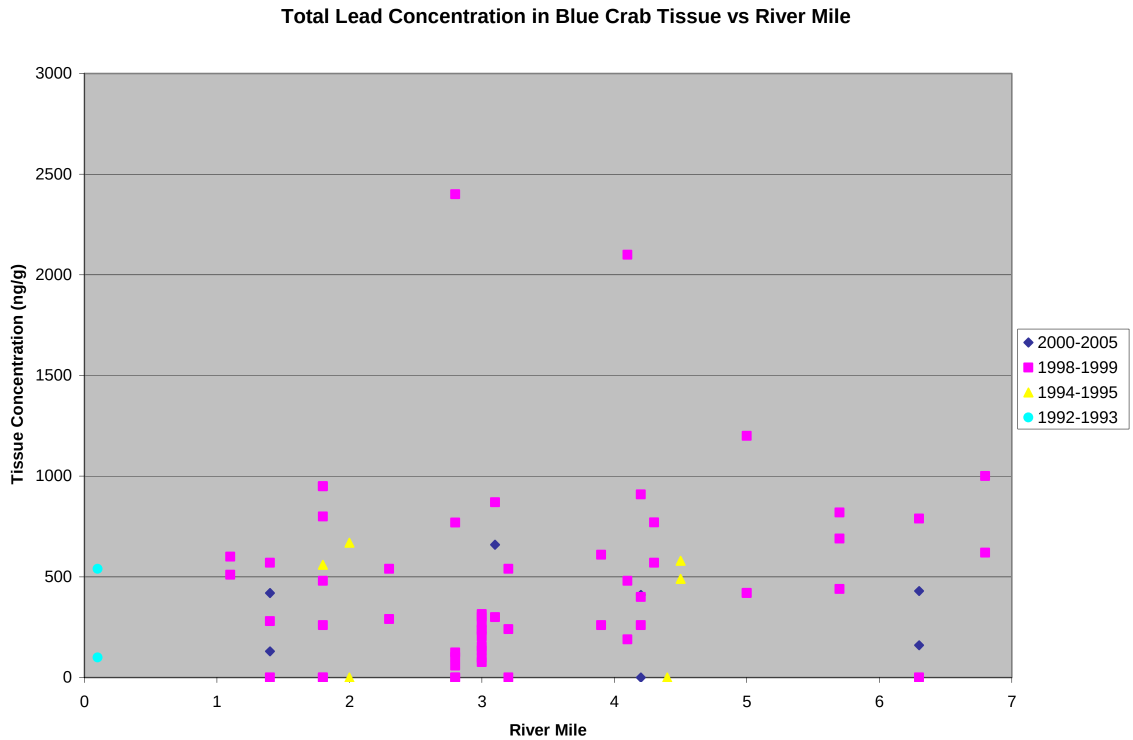

Total Mercury Concentration in White Perch Tissue vs River Mile
Tissue Concentration (ng/g)
1000
800
600
400
200
0
0
1
2
3
4
5
6
7
River Mile
2000-2005
1998-1999
1994-1995

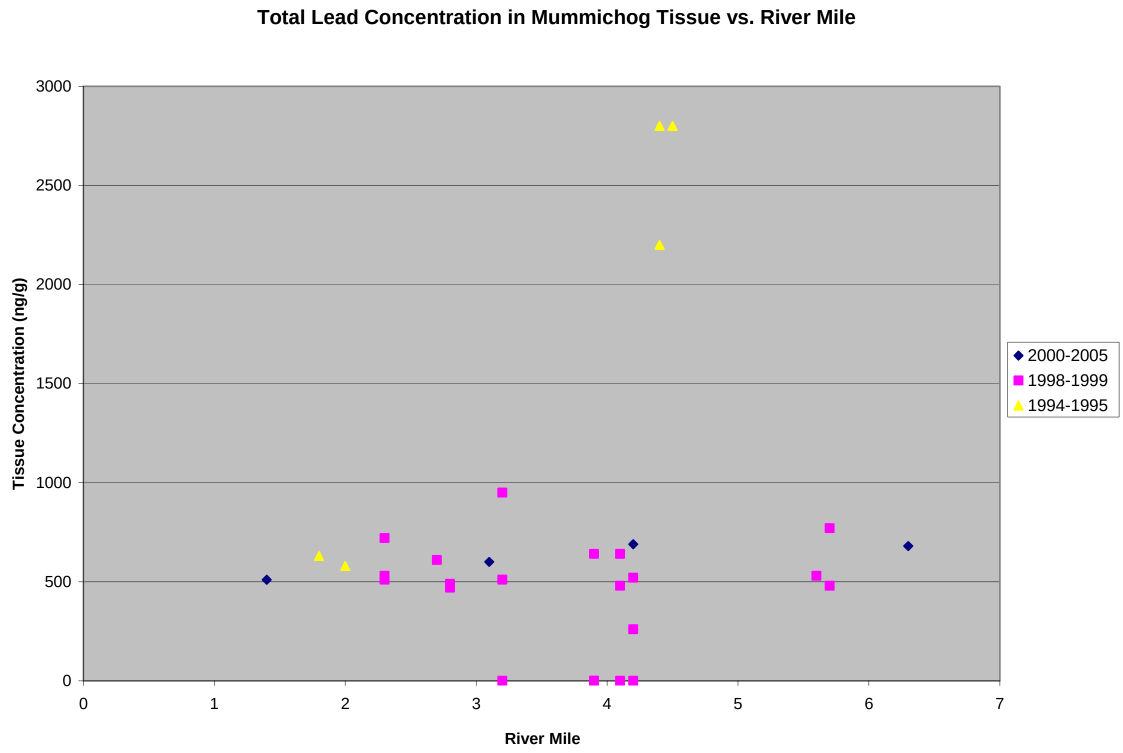
I.7 Ratio of Methyl Mercury to Total Mercury



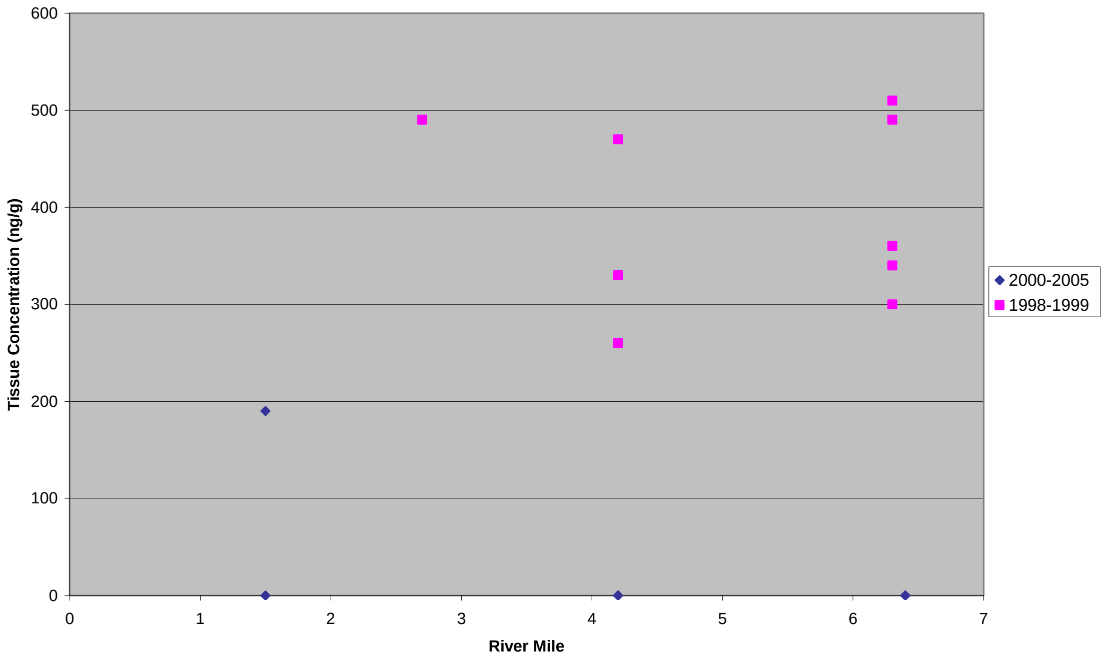


I.8 Total Lead





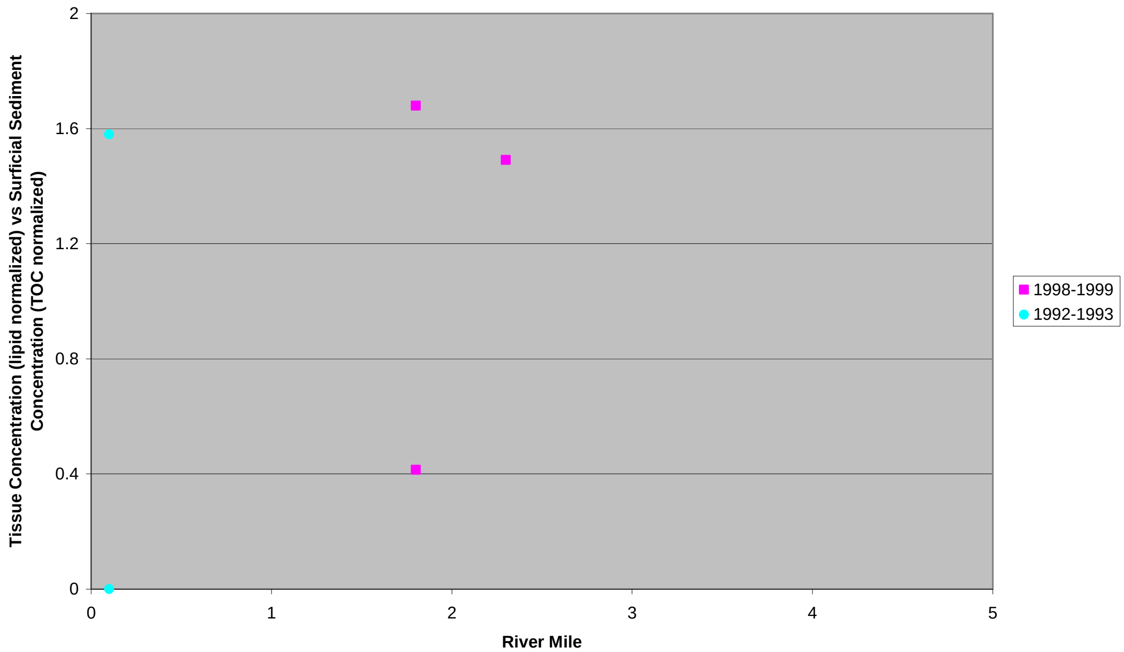
Total Lead Concentration in White Perch Tissue vs River Mile



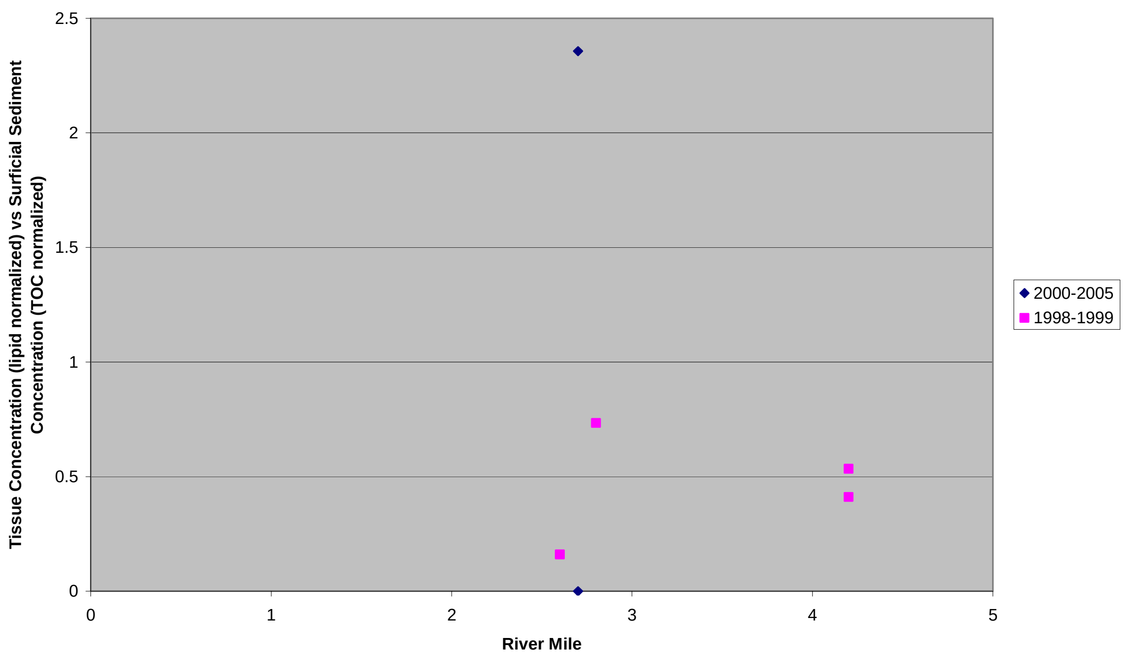
Deliverable II

II.1 Total DDT

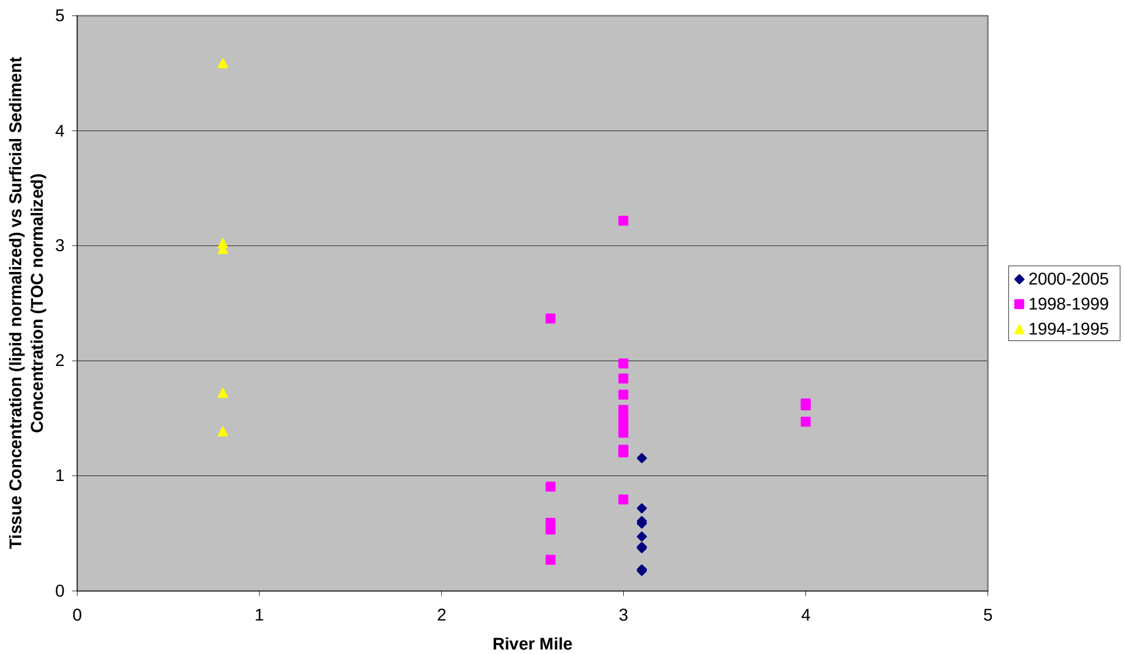
Ratio of Total DDT Concentration in Blue Crab Tissue (lipid normalized) vs Concentration in Surficial Sediment (TOC normalized)



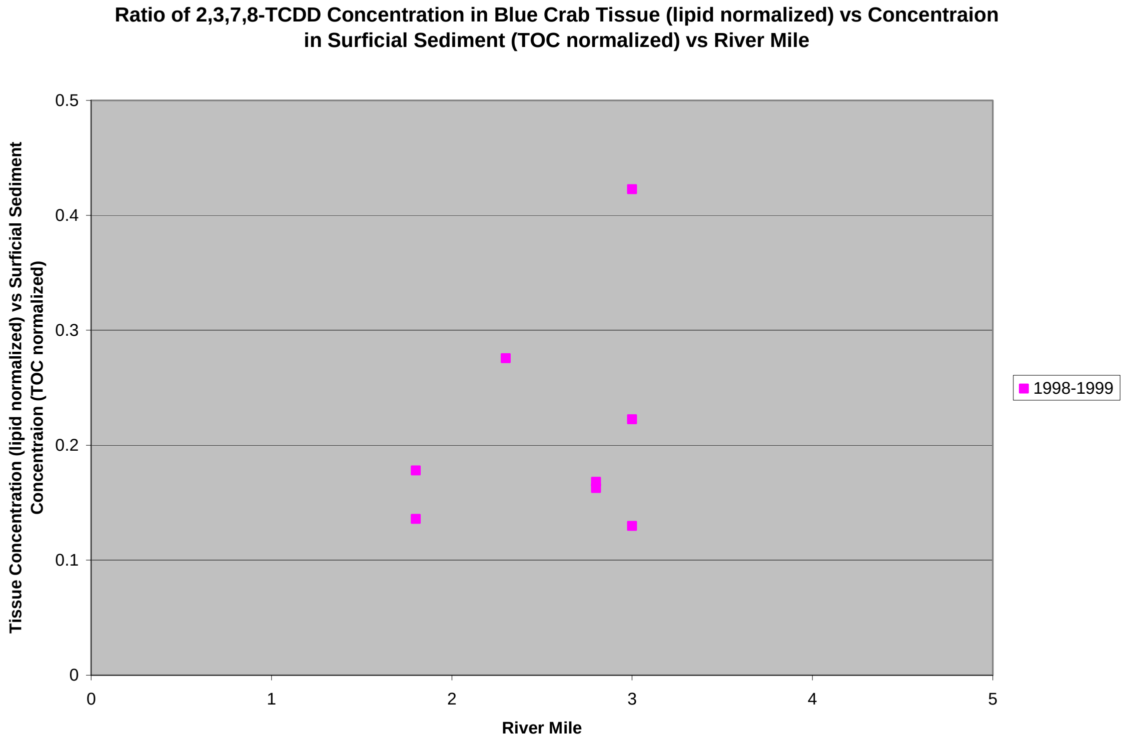
Ratio of Total DDT Concentration in Mummichog Tissue (lipid normalized) vs Concentration in Surfiical Sediment (TOC normalized) vs River Mile

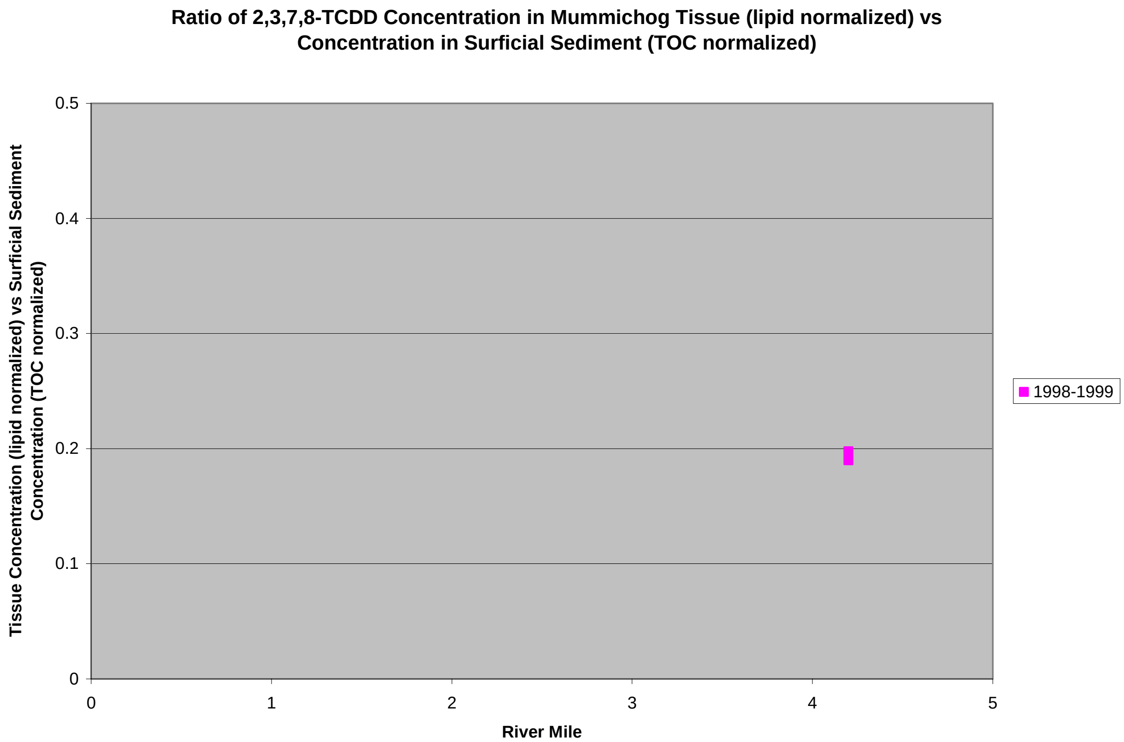


Ratio of Total DDT Concentration in White Perch Tissue (lipid normalized) vs Concentration in Surficial Sediment (TOC normalized) vs River Mile

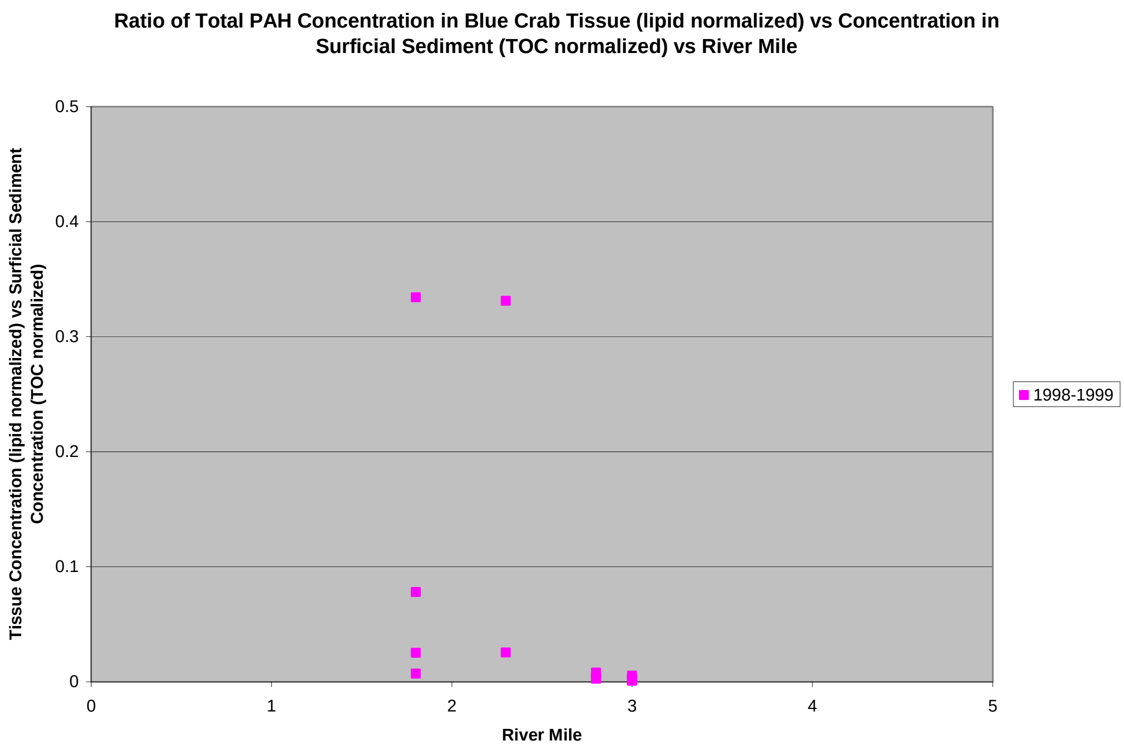


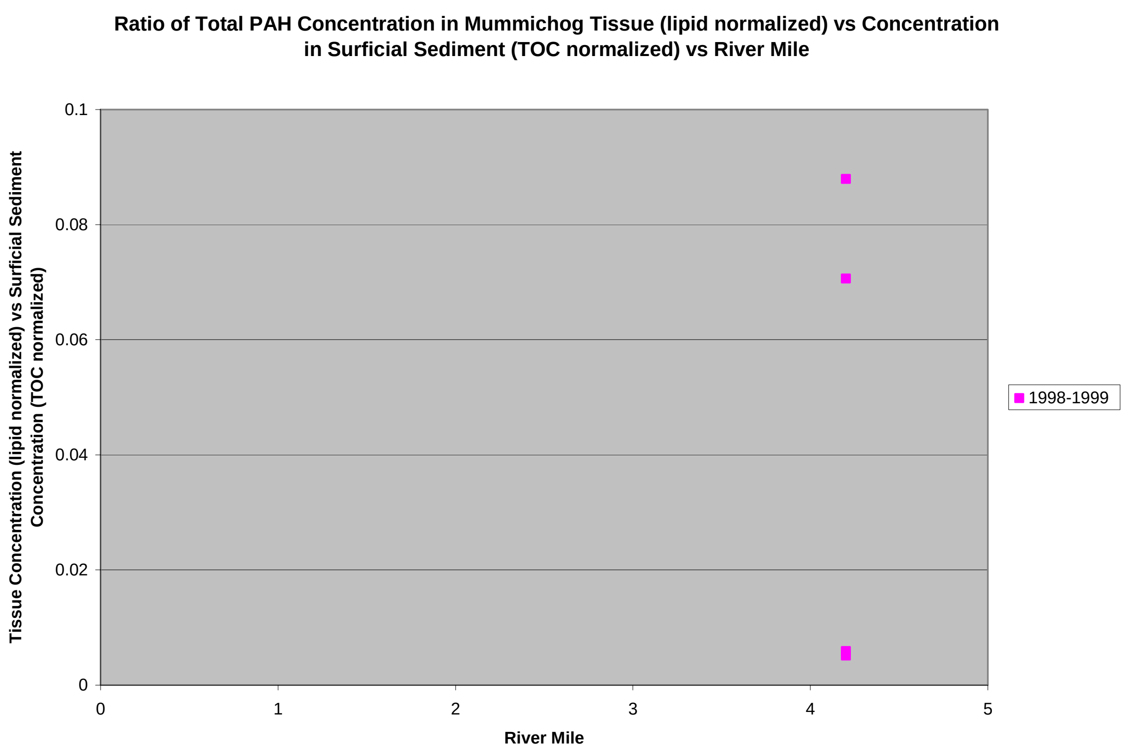
II.2 2,3,7,8-TCDD



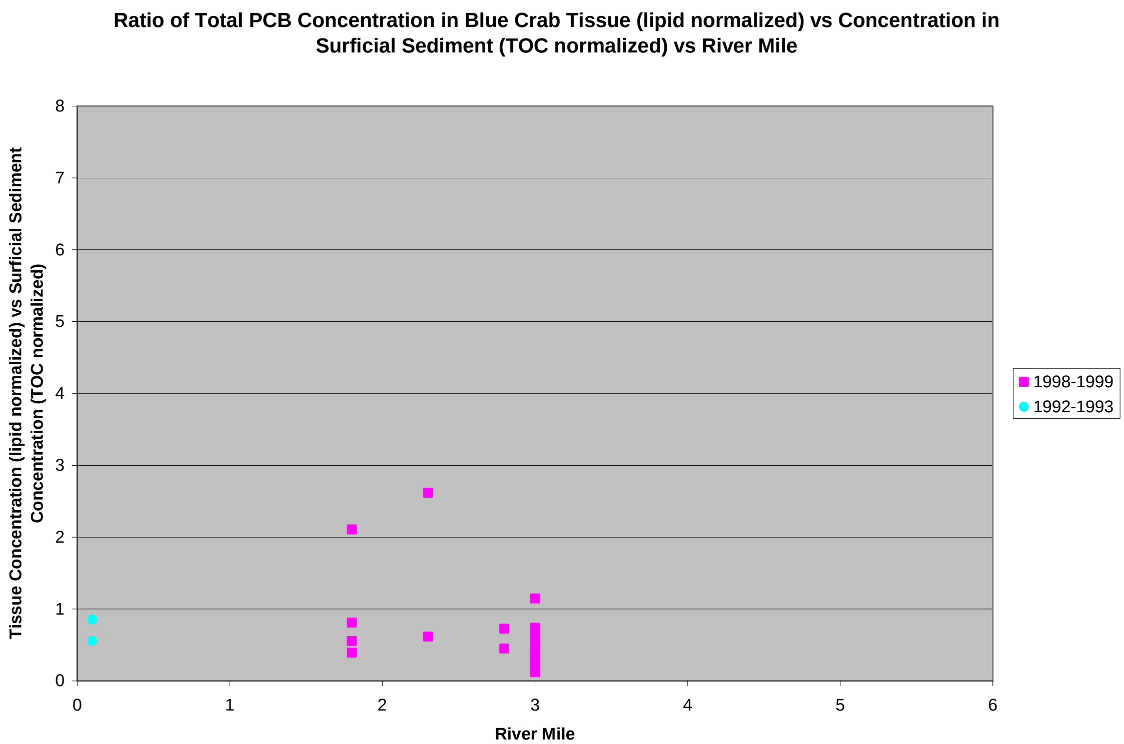


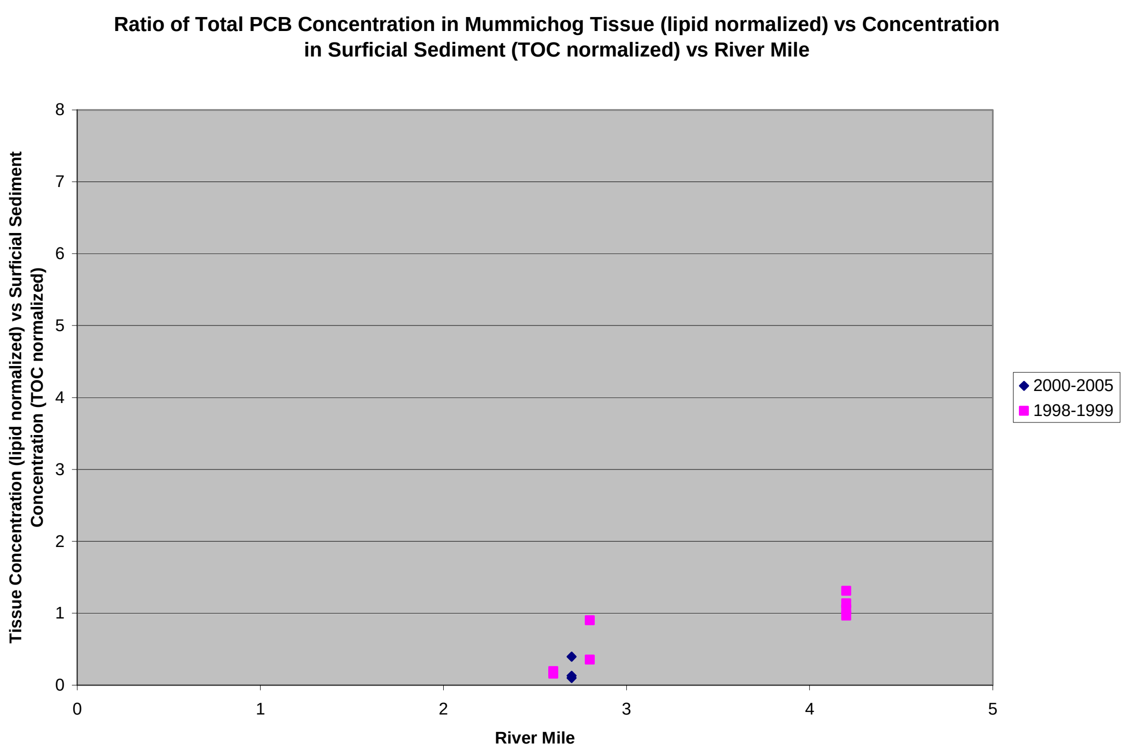
II.4 Total PAH

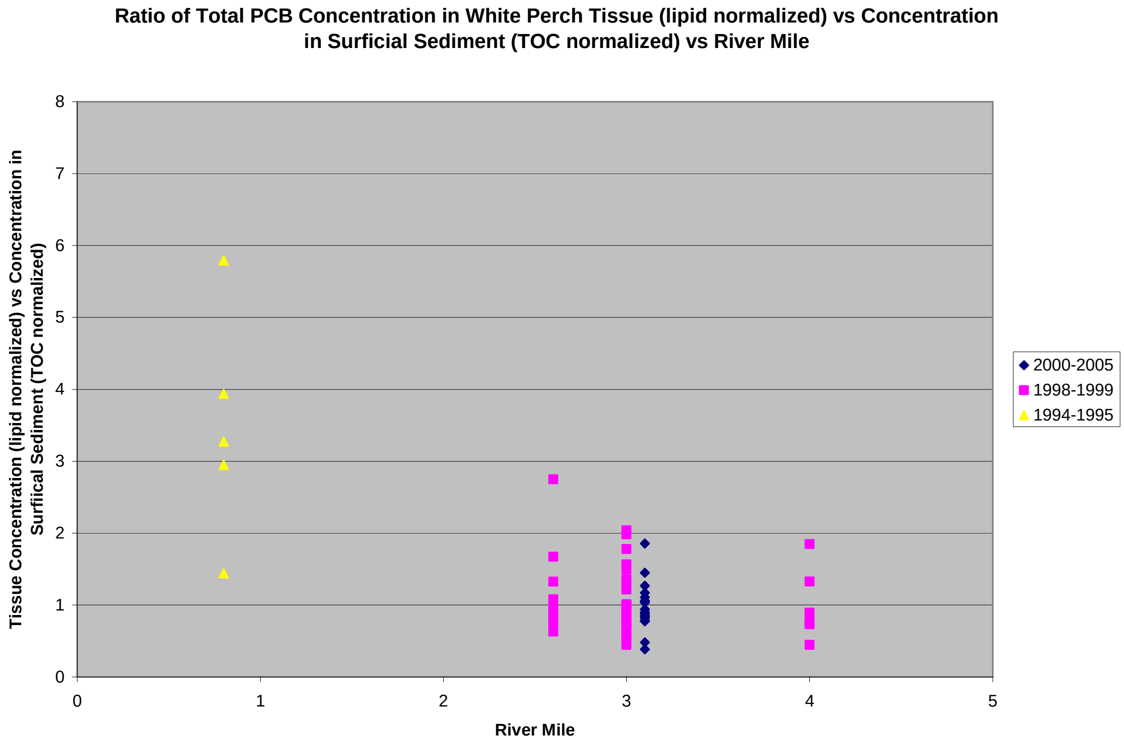




II.5 Total PCB

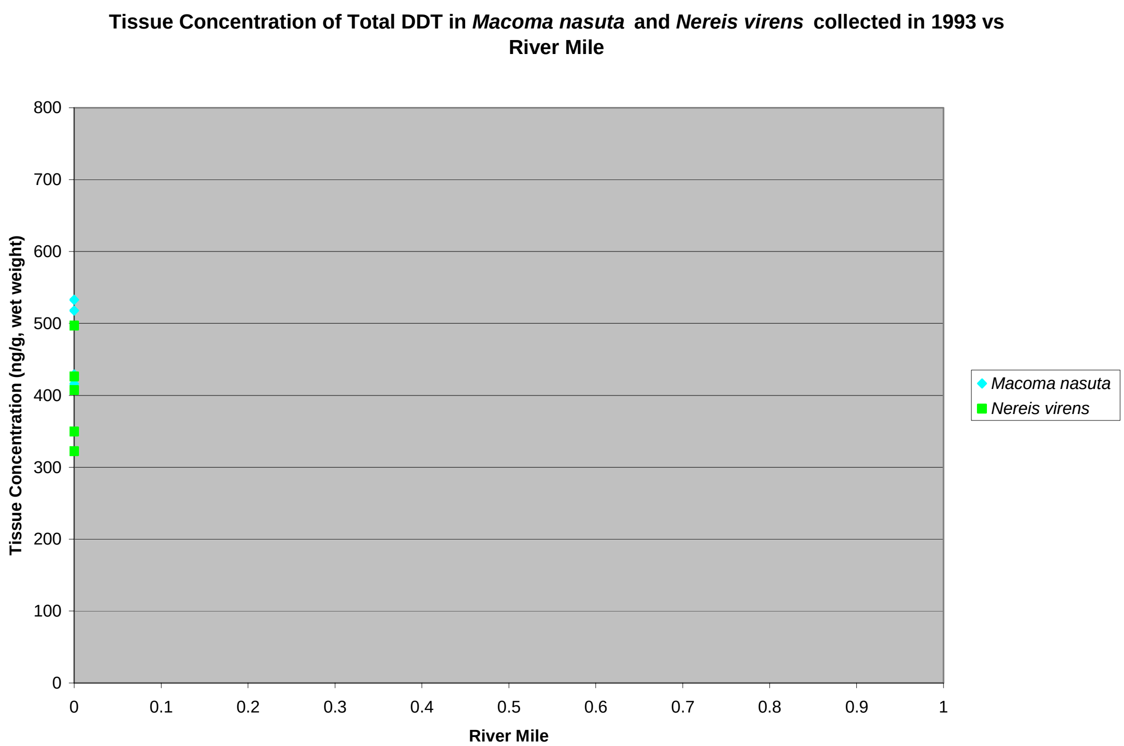




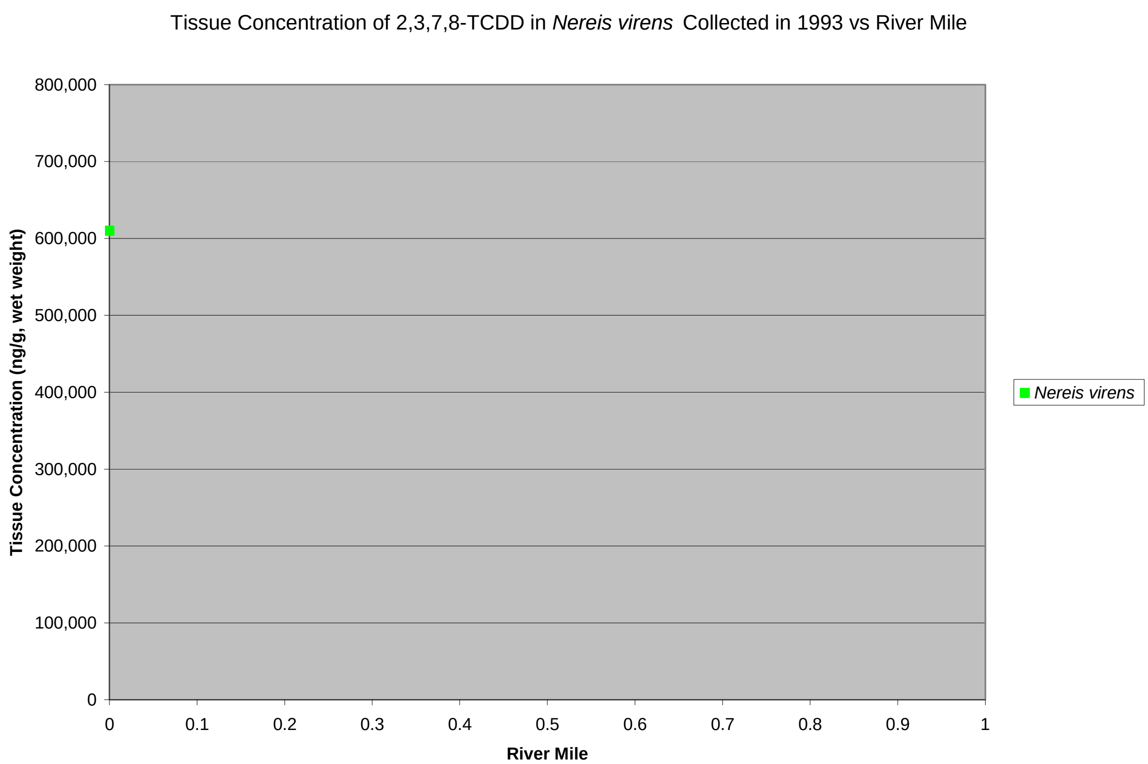

Ratio of Total PCB Concentration in White Perch Tissue (lipid normalized) vs Concentration in Surficial Sediment (TOC normalized) vs River Mile
Tissue Concentration (lipid normalized) vs Concentration in Surfiical Sediment (TOC normalized)
River Mile
2000-2005
1998-1999
1994-1995
0
1
2
3
4
5
6
7
8

Deliverable III

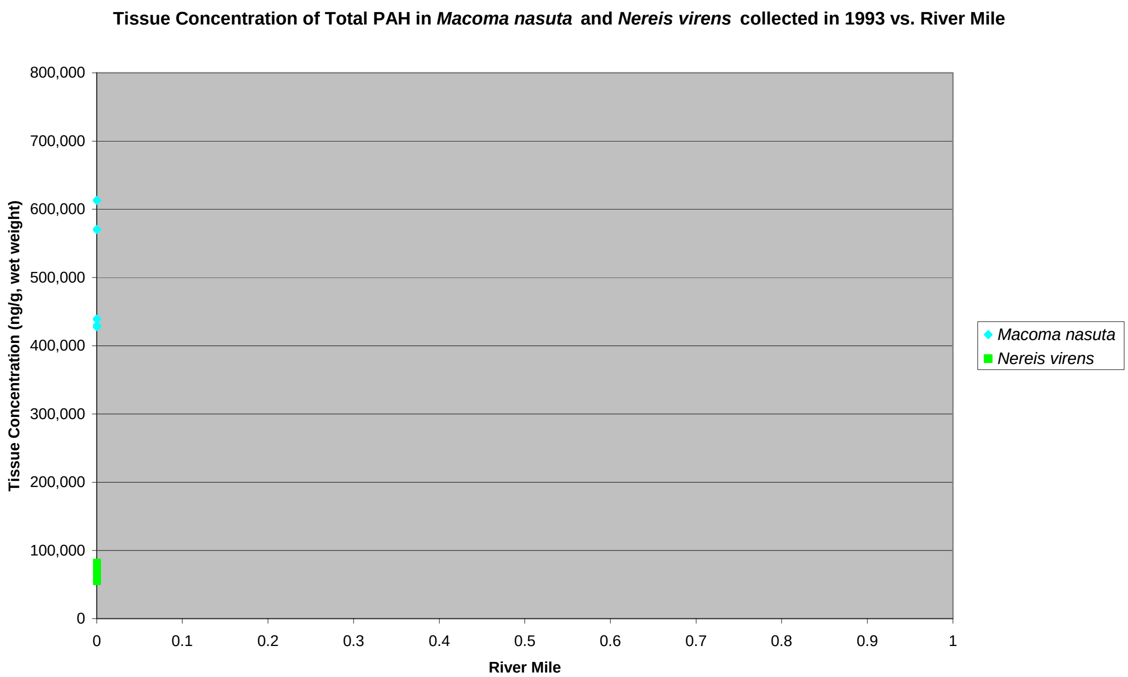
III.1 Total DDT



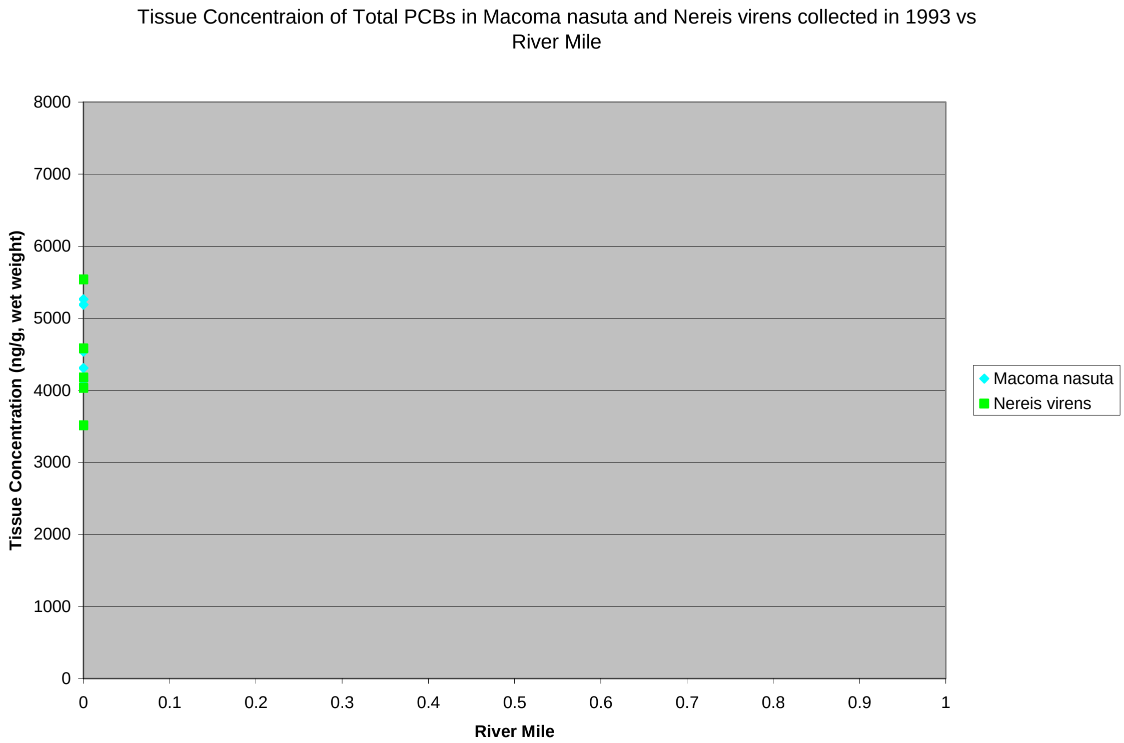
III.2 2,3,7,8-TCDD



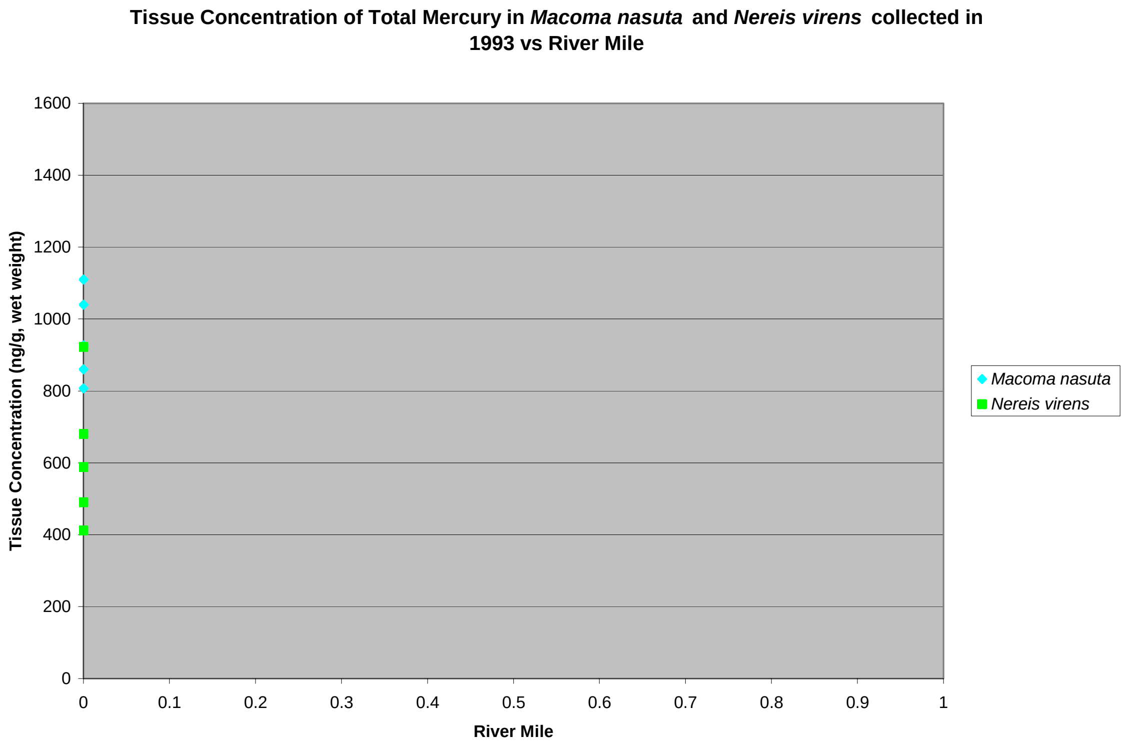
III.3 Total PAH



III.4 Total PCB



III.5 Total Mercury



III.6 Total Lead